Memorandum

To: Carolyn Jones, DAIM-ODB
Laura Roebuck, USACE-Mobile

From: Tom Holmes

Date: 29 August 2016

Re: **Supplemental Remedial Investigation Phase 2 Work Plan, Revision 1**
Defense Depot Memphis, Tennessee

HDR has prepared this work plan to describe installation of Phase 2 monitoring wells on the Main Installation (MI) at Defense Depot Memphis, Tennessee (DDMT). This work plan was prepared for the Office of the Assistant Chief of Staff for Installation Management, Base Realignment and Closure Division (ODB) under Contract W90FYQ-09-D-0005, Task Order CK04 with the U.S. Army Corps of Engineers, Mobile District (USACE-Mobile).

The work plan has been revised in accordance with approved responses to United States Environmental Protection Agency (USEPA) and Tennessee Department of Environment and Conservation (TDEC) comments. The responses to comments and approval letters are provided in Appendix A.

INTRODUCTION

Remedial action objectives (RAOs) for the MI were established in the *Main Installation Record of Decision* (MI ROD) (CH2M HILL 2001). The groundwater RAOs are to prevent ingestion of water contaminated with volatile organic compounds (VOCs) in excess of maximum contaminant levels (MCLs) from potential future on-site wells; to restore groundwater to concentrations at or less than MCLs; and to prevent migration horizontally and vertically offsite of groundwater contaminants in excess of MCLs.

The selected groundwater remedy in the MI ROD is enhanced bioremediation of chlorinated volatile organic compounds (CVOCs) in the most contaminated part of the groundwater plume; long-term monitoring (LTM) to document changes in plume concentrations and to detect potential plume migration to off-site areas or into deeper aquifers; and deed restrictions and site controls to prevent production or use of groundwater, and drilling into deeper aquifers on the MI. The selected remedy was based on the understanding that "untreated parts of the groundwater plume would degrade under natural attenuation". Groundwater concentrations of 100 micrograms per liter (µg/L) for tetrachloroethene (PCE) and trichloroethene (TCE) were used to delineate the treatment areas.

Enhanced bioremediation treatment (EBT) was implemented through injections of sodium lactate solution and performance monitoring, initially in two areas from September 2006 to March 2009 and again in five areas from August 2012 through

November 2014. CVOC concentrations were reduced significantly in the treatment areas, but reduced CVOC concentrations were not seen outside the treatment areas and the estimated schedule to achieve RAO was not being met. This Supplemental Remedial Investigation (SRI) and the following Focused Feasibility Study (FFS) are being conducted to develop a remedial strategy to achieve RAOs throughout the MI.

The SRI/FFS scope of work consists of the following tasks:

- Review site documents to identify data requirements for site hydrogeology and contaminant extent and for evaluation of remedial alternatives.
- Update the conceptual hydrogeological site model with data collected since implementation of remedial action.
- Review the previous groundwater model which was limited in scope to provide an initial assessment of contaminant migration and potential impacts to the Memphis Aquifer (MAQ). Determine revisions to the model program and to site parameters that would be required to provide a more detailed model; and identify additional data needs.
- Identify data gaps regarding groundwater flow and contaminant migration and whether more detailed modeling is warranted.
- Prepare work plans and conduct two phases of additional field investigation.
- Prepare an SRI report to describe the field investigation, present validated analytical results, and further characterize the nature and extent and fate and transport of groundwater contamination at the MI. A detailed risk assessment is not within the current scope; the current RAO requiring restoration of groundwater to concentrations at or less than MCLs is not expected to change.
- Prepare an FFS based on SRI results which shall include development and screening of remedial action alternatives, including EBT as the currently selected remedy. Develop a limited number of alternatives for detailed analysis to establish the basis for an alternative remedy selection, if warranted.
- Document changes to the selected remedy and schedule through an Explanation of Significant Differences (ESD), or a Revised Proposed Plan and ROD Amendment, following completion of the SRI/FFS.

The SRI Phase 1 Work Plan (HDR, 2015) was approved by TDEC in March 2015 and USEPA in April 2015. Twelve monitoring wells within and adjacent to the MI were installed and groundwater samples were collected from April to July 2015. The SRI Phase 1 Summary Report, Revision 0 (HDR, 2016), which describes the review of site documents and previous groundwater modeling and the results of the field investigation, was submitted to USEPA and TDEC on 25 February 2016. The report was approved by EPA on 29 April 2016, with the understanding that additional contaminant transport modeling would be discussed with EPA and TDEC. TDEC approved responses to their comments on 12 May 2016; the final SRI report will incorporate the approved responses. The findings from the SRI Phase 1 Summary Report are summarized below:

- Groundwater flow direction in the MAQ at DDMT, based on the 1995 contours, is west-northwest toward the Allen Well Field.

- Hydraulic connections (windows) between the Fluvial Aquifer and the MAQ are present throughout the Memphis area and one is located in the northwestern area of the MI.
- Groundwater elevations in the south-central MI suggest a sink in the Fluvial Aquifer with leakage to the intermediate aquifer (IAQ) in that area. Groundwater elevations suggest flow in the Fluvial Aquifer enters the MI from all sides and migrates vertically through the window in the northwest MI or towards the sink in the south-central MI.
- Naturally occurring biodegradation of CVOCs does not appear to be a significant contributor to natural attenuation in the Fluvial Aquifer at the MI. However, 1st order decay rates calculated for the 2009 groundwater model had good agreement with PCE and TCE concentrations at wells along the flow paths, which indicates attenuation is occurring.
- The 2009 model results are in good agreement with PCE and TCE concentrations in the IAQ and MAQ monitoring wells near the window. Current concentrations in the model source areas in the Fluvial Aquifer have been reduced by EBT and are much lower than the modeled concentrations.
- Upgradient impacts were identified at the North-Central and TTA-1N plumes, and delineation of the West-Central, TTA-2 and North-Central plumes were improved.
- Relatively high concentrations of TCE and cDCE were detected at MW-270 on the southern MI boundary. The location is not downgradient of a designated plume, and a discrete source near or upgradient of MW-270 is suspected.
- No CVOCs were detected in the new IAQ wells limiting extent of CVOCs to the west of MW-256. Groundwater flow in the IAQ at the northwestern MI is apparently to the north rather than northwest as previously shown.

PHASE 2 WORK PLAN

This Phase 2 Work Plan is an update of the *SRI Phase 1 Work Plan* and is limited to project specific information. It was prepared in general accordance with *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), Version 1, Part 1: UFP-QAPP Manual*, (Intergovernmental Data Quality Task Force, 2005) and is to be used with the DDMT generic QAPP, *Remedial Action Operations and Long Term Monitoring Quality Assurance Project Plan* (RAO-LTM QAPP) (HDR, 2014).

The results from Phase 1 of the SRI and the October 2015 LTM results were reviewed to identify data gaps requiring additional investigation. The review identified 12 data gaps and recommended 29 monitoring wells be installed to address the data gaps. The available funding is not sufficient to install all the recommended wells in Phase 2 of the SRI. The data gaps and recommended well locations were prioritized, and one IAQ well and eight Fluvial Aquifer wells will be installed on and adjacent to the MI during Phase 2 of the SRI. The Phase 2 well locations are shown on Figures 1 and 2 and are listed on Table 1.

An SRI Phase 3 investigation is planned to install the remaining wells and address all the identified data gaps. Pending approval of the scope and available funding, the additional wells will be installed in early 2017.

QAPP worksheets, which required revision from the RAO-LTM QAPP, are provided in Appendix B. Standard operating procedures which will guide SRI Phase 2 activities are provided in Appendix C.

TABLES

TABLE 1
PROPOSED WELL LOCATIONS AND DEPTHS
SRI PHASE 2 WORK PLAN
Defense Depot Memphis, Tennessee

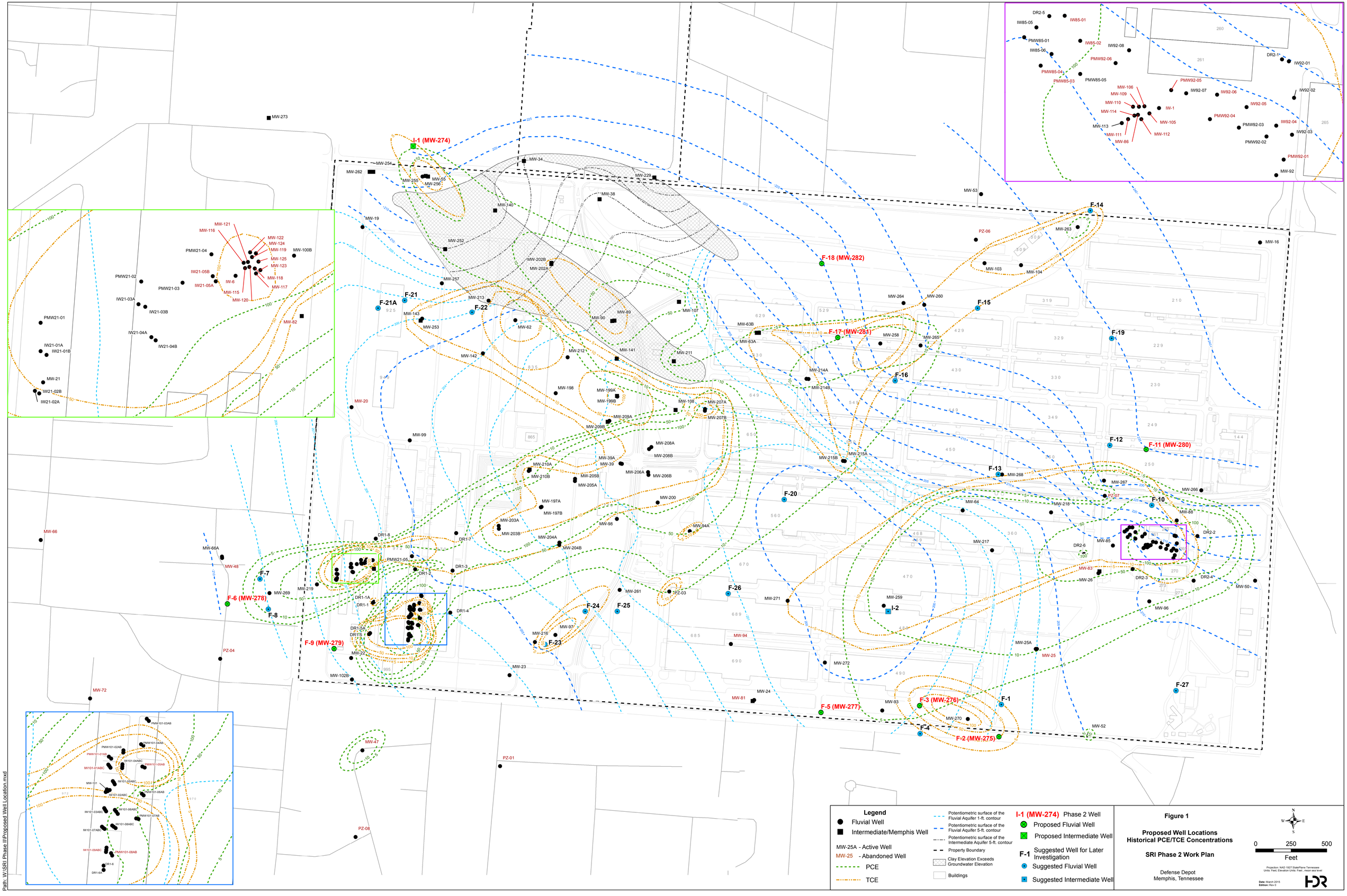
Well	Northing (ft)	Easting (ft)	Aquifer	Estimated Groundwater Depth (ft)	Estimated Top of Clay Depth (ft)	Estimated Fluvial Aquifer Thickness (ft)	Estimated Surface Casing Depth (ft)	Estimated Top of Screen Depth (ft)	Estimated Well Depth (ft)	Estimated Boring Depth (ft)
MW-274	801139	279515	Intermediate	124	74	NA	84	140	150	150
MW-275	805261	275359	Fluvial	77	90	13	NA	80	90	95
MW-276	804704	275576	Fluvial	93	106	13	NA	96	106	111
MW-277	804009	275529	Fluvial	96	110	14	NA	100	110	115
MW-278	799831	276293	Fluvial	80	103	23	NA	93	103	108
MW-279	800582	275978	Fluvial	88	128	40	NA	118	128	133
MW-280	806298	277379	Fluvial	69	88	19	NA	78	88	93
MW-281	804127	278167	Fluvial	87	125	38	NA	115	125	130
MW-282	804014	278689	Fluvial	84	97	13	NA	87	97	102

Note:

1) All monitoring wells will have 10-foot screens.
2) Estimated groundwater depths are for the Intermediate Aquifer at MW-274 and for the Fluvial Aquifer at the other Phase 2 wells.

NA: Not applicable

FIGURES


I-1 (MW-274)
F-18 (MW-282)
F-17 (MW-281)
F-6 (MW-278)
F-9 (MW-279)
F-5 (MW-277)
F-3 (MW-276)
F-2 (MW-275)
F-11 (MW-280)
F-14
F-15
F-16
F-19
F-12
F-13
F-10
F-20
F-21
F-21A
F-22
F-23
F-24
F-25
F-26
F-7
F-8
F-4
F-1
F-27
I-2
MW-273
MW-254
MW-262
MW-255
MW-256
MW-55
MW-34
MW-229
MW-38
MW-140
MW-19
MW-252
MW-202B
MW-202A
MW-257
MW-213
MW-143
MW-253
MW-62
MW-89
MW-90
MW-107
MW-141
MW-211
MW-212
MW-142
MW-198
MW-199A
MW-199B
MW-198
MW-207A
MW-207B
MW-209A
MW-209B
MW-99
MW-208A
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MW-39A
MW-39
MW-210A
MW-210B
MW-205B
MW-205A
MW-206A
MW-206B
MW-200
MW-197A
MW-197B
MW-203A
MW-203B
MW-204A
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MW-98
MW-94A
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PZ-06
MW-103
MW-104
MW-263
MW-16
MW-264
MW-260
MW-63B
MW-63A
MW-258
MW-265
MW-214A
MW-214B
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MW-64
MW-268
MW-267
PZ-07
MW-266
MW-218
MW-217
MW-88
DR2-2
MW-85
DR2-6
MW-83
MW-26
DR2-3
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MW-50
MW-96
MW-25A
MW-25
MW-259
MW-271
MW-261
PZ-03
MW-94
MW-272
MW-24
MW-81
MW-93
MW-270
MW-52
MW-66
MW-66A
MW-48
MW-269
MW-219
DR1-8
DR1-7
DR1-3
DR1-2
DR1-1A
DR1-1
DR1-4
DR1-5A
DR1-5
MW-22
MW-102B
MW-23
PZ-04
PZ-01
PZ-08
MW-47
MW-72
MW-20
PMW21-05
MW-216
MW-97
MW-92
DR-1-6
DR-1-6A
DR2-5
IW85-05
IW85-01
PMW85-01
IW85-02
IW85-06
PMW92-06
PMW85-04
PMW85-03
PMW85-05
IW92-08
DR2-1
IW92-01
PMW92-05
IW92-07
IW92-06
IW92-02
MW-106
MW-109
MW-110
MW-114
MW-113
MW-111
MW-86
MW-112
MW-105
IW-1
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IW21-05B
IW21-05A
PMW21-04
MW-100B
PMW21-02
PMW21-03
IW21-03A
IW21-03B
MW-82
IW21-04A
IW21-04B
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IW21-01B
MW-21
IW21-02B
IW21-02A
PMW101-03AB
PMW101-04AB
PMW101-02AB
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IW101-04ABC
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MW-101
IW101-05ABC
IW101-02ABC
PMW101-06AB
IW101-03ABC
IW101-06ABC
PMW101-07AB
IW101-07ABC
IW101-08ABC
IW101-09ABC
PMW101-08AB
DR1-6
DR1-6A
Legend
Fluvial Well
Intermediate/Memphis Well
MW-25A - Active Well
MW-25 - Abandoned Well
PCE
TCE
Potentiometric surface of the Fluvial Aquifer 1-ft. contour
Potentiometric surface of the Fluvial Aquifer 5-ft. contour
Potentiometric surface of the Intermediate Aquifer 5-ft. contour
Property Boundary
Clay Elevation Exceeds Groundwater Elevation
Buildings
I-1 (MW-274) Phase 2 Well
Proposed Fluvial Well
Proposed Intermediate Well
F-1 Suggested Well for Later Investigation
Suggested Fluvial Well
Suggested Intermediate Well
Figure 1
Proposed Well Locations
Historical PCE/TCE Concentrations
SRI Phase 2 Work Plan
Defense Depot
Memphis, Tennessee
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Feet
Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet , mean sea level
Date: March 2015
Edition: Rev 0
HDR
Path: W:\SRI Phase II\Proposed Well Location.mxd


MW-274
MW-282
MW-281
MW-280
MW-279
MW-278
MW-277
MW-276
MW-275
MW-273
MW-34
MW-294
MW-262
MW-255
MW-256
MW-55
MW-229
MW-38
MW-140
MW-19
MW-252
MW-202B
MW-202A
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DR1-3
DR1-4
DR1-7
PMW21-05
MW-20
925
940
Legend
Fluvial Well
Intermediate/Memphis Well
MW-274 Phase 2 Well
Proposed Fluvial Well
Proposed Intermediate Well
MW-25A - Active Well
MW-25 - Abandoned Well
Property Boundary
Clay Elevation Exceeds Groundwater Elevation
Buildings
Figure 2
Proposed Well Locations AerialView
SRI Phase 2 Work Plan
Defense Depot
Memphis, Tennessee
N
W
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250
500
Feet
Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet , mean sea level
Date: March 2015
Edition: Rev 0
Path: W:\SRI Phase II\Proposed Well Location - Aerial.mxd

APPENDIX A
RESPONSES TO USEPA AND TDEC COMMENTS

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
MEMPHIS ENVIRONMENTAL FIELD OFFICE
8383 WOLF LAKE DRIVE
BARTLETT, TN 38133-4119
PHONE (901) 371-3000 STATEWIDE 1-888-891-8332 FAX (901) 371-3170

June 29, 2016

Carolyn Jones
Program Manager
Office of the Chief of Staff for Installation Management
Attn: BRAC Division (DAIM-ODB)
2530 Crystal Drive (Taylor Bldg.), Room 5000
Arlington, VA 22202-3940

Subject: **Supplemental Remedial Investigation Phase 2 Work Plan, (Rev 0)**
Defense Depot Memphis, Tennessee
TDoR ID # 79-736
EPA ID # TN 4210020570

Ms. Jones,

TDEC-DoR has reviewed the **Supplemental Remedial Investigation Phase 2 Work Plan,** as compiled by T. Holmes (HDRInc), and approves of the document and the proposed well locations for Phase 2. If there are questions or concerns, please contact me at (901) 371-3041 or at jamie.woods@tn.gov .

Regards,

Jamie A. Woods, P.G.
Project Manager
Division of Remediation
Memphis Environmental Field Office

cc: Thomas C. Holmes (HDRInc)
Diedre Lloyd (EPA-PM)
Joan Hutton (CALIBRE)
TDoR NCO: file 79-736
TDoR MEFO: file 79-736

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

August 18, 2016

UPS NEXT DAY AIR
RETURN RECEIPT REQUESTED

Ms. Carolyn Jones
Assistant Chief of Staff for Installation Management
Base Realignment and Closure Division (ACSIM-ODB)
2530 Crystal Drive (Taylor Building), Room 5000
Arlington, VA 22202-3940

Dear Ms. Jones:

The U.S. Environmental Protection Agency (EPA) has received and reviewed the U.S. Army's, Defense Depot of Memphis Depot Supplemental Remedial Investigation Phase 2 Work Plan Report along with the response to EPA comments.

EPA approves the above referenced report which incorporates the agreed upon response to comments.

If you have any questions or concerns, please contact me at (404) 229-9500.

Sincerely,

Diedre Lloyd /cf

Diedre Lloyd
Remedial Project Manager
Restoration and Sustainability Branch
Superfund Division

cc: Mr. Jamie A. Woods, PG, Tennessee, Department of Environment and Conservation, Memphis Environmental Field Office, 8383 Wolf Lake Drive, Bartlett, TN 38133-4119
Ms. Joan Hutton, CALIBRE, 3898 Mountain View Road, Kennesaw, GA 30152
Mr. Thomas Holmes, HDR Environmental, P.O. Box 728, Highlands, NC 28741

Responses to:
U.S. Environmental Protection Agency (EPA) Region 4 Comments on:
Supplemental Remedial Investigation Phase 2 Work Plan, Revision 0
Defense Depot Memphis, Tennessee
July 30, 2016

EPA Comments:

1. Based on the Supplemental Remedial Investigation Phase 2 Work Plan, Revision 0, Defense Depot Memphis, Tennessee, dated June 3, 2016 (SRI Phase 2 WP), the intent of Phase 2 of the Supplemental Remedial Investigation (SRI) is to address remaining data gaps. Yet it is unclear how the nine proposed monitoring wells to be installed on and adjacent to the Main Installation (MI) during Phase 2 of the SRI will address the data gaps identified during Phase 1 of the SRI. For example, in Appendix B, Project-Specific Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) Worksheets, QAPP Worksheet #10 (Problem Definition) indicates that several data gaps will not be addressed at all during Phase 2 of the SRI. Specifically,

    a. Monitoring Well I-2 will not be installed to evaluate the potential impacts in indoor air quality from the sink;
    b. Monitoring Wells F-7 and F-8 will not be installed to evaluate the extent of chlorinated volatile organic compounds (CVOCs) sidegradient of MW-269;
    c. Monitoring Wells F-10, F12, and F-13 will not be installed to evaluate the extent of CVOCs upgradient of TTA-2W;
    d. Monitoring Wells F-14, F-15, and F-16 will not be installed to evaluate the extent of volatile organic compounds upgradient and side-gradient of the N-C plume;
    e. Monitoring Wells F-21 and F-22 will not be installed to evaluate the extent of CVOCs upgradient of B835;
    f. Monitoring Wells F-23, F-24, F-25, and F-26 will not be installed to evaluate the extent of contamination in the S-C plume; and,
    g. Monitoring Well F-27 will not be installed to evaluate the southeast MI.

    While these monitoring wells are suggested for later investigation, this information is not clearly presented in the text. For example, QAPP Worksheet #9 (Project Scoping Session Participant Sheet) states, "Locations were recommended for 2 wells screened in the IAQ and 28 wells screened in the Fluvial Aquifer. Although the wells are expected to be added in the near future, the SRI Phase 2 funding is limited to 1 Intermediate Aquifer (IAQ) well and 8 Fluvial Aquifer wells." As such, the information presented in QAPP Worksheet #9 indicates the selection of the proposed 9 monitoring wells was due to limited SRI Phase 2 funding. Please revise the text of the SRI Phase 2 WP to clarify that the proposed 9 monitoring wells will not address all the data gaps identified during Phase 1 of the SRI and a schedule of when additional wells are expected to be added in the near future (see General Comment No. 2, below.).

    Response: Phase 2 of the SRI is intended to address the highest priority data gaps by installation of 9 monitoring wells, as noted in Worksheet #s 9 and 10. The cover memorandum and the applicable worksheets will be revised to clarify that all identified data gaps will not be addressed and to provide an estimated start date for installation of the remaining wells at the recommended locations.

2. Based on QAPP Worksheet #10 (Problem Definition), several monitoring wells are suggested for later investigation; however, the SRI Phase 2 WP does not discuss any follow-on investigations. Similarly, QAPP Worksheet #16 (Project Schedule/Timeline Table) does not include any follow-on investigations as part of the project schedule/timeline. As a result, it is unclear if the monitoring wells suggested for later investigation are part of a Phase 3 of the SRI or are contingent on the results of Phase 2 of the SRI. Revise the SRI Phase 2 WP to include information regarding the installation of monitoring wells suggested for later investigation.

    Response: The wells suggested for later investigations are not included in Phase 2 of the SRI due to available funding; thus, details for their installation are not provided. As noted in the response to Comment #1, an estimated start date for installation of the remaining wells will be provided.

3. Page 2, second bulleted item: Please clarify if the hydrogeological model referenced in this paragraph is intended to be the Site Conceptual Model (CSM)?
    a. If so, please state this in the report text.
    b. If not, please provide additional clarification as what specific model is being referenced.

    Response: The referenced "hydrogeological model" is intended to be the Conceptual Site Model. The text will be revised to "Update the conceptual hydrogeological site model …".

4. EPA appreciates the US Army and its respective contractors along with the TDEC PM's participation in a discussion of future groundwater modeling on July 27, 2016. EPA understands that this effort is not funded as of yet and that this was an initial discussion in support of a future narrowly focused but not overly complicated effort that will meet the stated goals as discussed by the FFA team and as outlined below.
    a. EPA would like to note that since a reliance on the previous 2009 groundwater modeling data has been cited in previous reporting efforts and is also cited in this report; it would be beneficial to update the model with respect to some deficiencies noted on the call along with determination of an anticipated time frame to meet RAOs and to understand the current groundwater hydrogeology and flow regimes onsite through an updated Conceptual Site Model and anticipated future modeling.

    Response: Army agrees that an updated groundwater model would be beneficial in planning further remedial action on the MI and estimating the time frame for meeting RAOs. The modeling scope is currently being developed and will include an updated CSM with computer modeling to follow, as discussed on the conference call. Pending approval of scope and funding, the CSM update should begin in early 2017.

    The comment is not considered to require revision of the WP.

5. Table 1: Proposed Well Locations and Depths: Please provide additional clarification as to why NA is noted for "Estimated Groundwater Depth (ft)" and for "Estimated Fluvial Aquifer Thickness (ft)" for MW 274 or provide the data based upon an estimation of previous site knowledge/experience.

    Response: Estimates for groundwater depth and Fluvial Aquifer thickness were not provided because MW-274 will be installed in the Intermediate Aquifer and measurement of the Fluvial Aquifer groundwater depth will not be made at that location. The estimated groundwater depth for the intermediate aquifer at the MW-274 location is 124 feet.

    Table 1 will be revised to include estimated groundwater depth of 124 feet at MW-274; Fluvial Aquifer thickness will not be estimated. A footnote will be added stating that the estimated groundwater depth is for the Intermediate Aquifer at MW-274 and for the Fluvial Aquifer at the other Phase 2 wells.

6. Please include the analytical laboratory method that will be used for VOC groundwater samples and include in the report.

    Response: References to the specific analytical laboratory method for VOC analysis of groundwater samples (SW-846 Method 5030B/8260B) will be added to Worksheet #11. The analytical methods are also listed in Worksheet #19, which was not included in the Phase 2 work plan as it is unchanged from the generic, site-wide QAPP.

APPENDIX B
PROJECT-SPECIFIC UFP-QAPP WORKSHEETS

WS 1 – Title and Approval

WS 2 – QAPP Identifying Information

WS 3 – Distribution List

WS 4 – Project Personnel Sign-Off Sheet

WS 5 – Project Organizational Chart

WS 7 – Personnel Responsibilities and Qualifications

WS 9 – Project Scoping Session Participants

WS 10 – Problem Definition

WS 11 – Project Quality Objectives/Systematic Planning Process

WS 13 – Secondary Data Criteria and Limitations

WS 14 – Summary of Project Tasks

WS 16 – Project Schedule/Timeline

WS 17 – Sampling Design and Rationale

WS 18 – Sampling Locations and Methods/SOP Requirements

QAPP Worksheet #1 (UFP-QAPP Manual Section 2.1) -- Title and Approval Page

SRI Phase 2 QAPP, DDMT, Revision 1
Document Title

Department of the Army (DA)
Lead Organization

Thomas Holmes, HDR
Preparer's Name and Organizational Affiliation

9781 South Meridian Blvd., Suite 400, Englewood, CO 80112
404-295-3279, thomas.holmes@hdrinc.com
Preparer's Address, Telephone Number, and E-mail Address

29 August 2016
Preparation Date (Day/Month/Year)

Investigative Organization's Project Manager: Thomas Holmes
Signature
Thomas Holmes/HDR/29 Aug 2016
Printed Name/Organization/Date

Investigative Organization's Project Quality Assurance (QA) Officer:

Lynn Lutz
Signature
Lynn Lutz/ HDR/29 Aug 2016
Printed Name/Organization/Date

USACE-Mobile Contracting Officer's Representative: Laura Roebuck
Signature
Laura Roebuck/ USACE Mobile/29 Aug 2016
Printed Name/Organization/Date

Lead Organization's Program Manager: Carolyn Jones
Signature
Carolyn Jones/ DA BRAC Office/29 Aug 2016
Printed Name/Organization/Date

Approval Signatures: Diedre Lloyd
Signature
Diedre Lloyd/USEPA Region/29 Aug 2016
Printed Name/Organization/Date

Jamie Woods
Signature
Jamie Woods/TDEC/ 29 Aug 2016
Printed Name/Organization/Date

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) - QAPP Identifying Information

Site Number/Code: TN4210020570
Operable Unit: OUs 2, 3 and 4
Contractor Name: HDR
Contract: W90FYQ-09-D-0005, Task Order CK04
Contract Title: Environmental Restoration Program Support, Defense Depot Memphis, Tennessee
HDR Project Number: 235772

1. Identify guidance used to prepare QAPP: *Uniform Federal Policy for Quality Assurance Project Plans, Version 1*, March 2005 EPA-505-B-04-900A, DTIC ADA 427785

2. Identify regulatory program: Comprehensive Environmental Response, Compensation & Liability Act (CERCLA) National Priorities List

3. Identify approval entities: USEPA Region 4, TDEC

4. Indicate whether the QAPP is ~~a generic or~~ a project-specific QAPP.

5. List dates of scoping sessions that were held: 21 April 2016.

6. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Approval Date
Remedial Action Operations and Long Term Monitoring (RAO-LTM) Quality Assurance Project Plan, Rev 1 HDR, December 2014	27 February 2015 (TDEC)
Supplemental Remedial Investigation Phase 1 Work Plan HDR, 8 April 2015	10 March 2015 (TDEC) 3 April 2015 (USEPA)

7. List organizational partners (stakeholders) and connection with lead organization: USEPA Region 4, TDEC – oversight organizations

8. List data users: HDR, ACSIM-ODB, USEPA Region 4, TDEC, USACE-Mobile

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below:
   All project–specific information is provided in the QAPP text or the worksheets listed below. Worksheets unchanged from the generic RAO-LTM QAPP are noted by "(G)" in the following tables and are not included with this submittal.
   Worksheets 6 and 8 are not included; the required information is provided in RAO-LTM QAPP Section 1.2.

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	WS 1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	WS 2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	WS 3 WS 4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	 WS 5 WS 7
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	WS 9 WS 10
2.6 Project Quality Objectives (PQOs) and Measurement Performance Criteria 2.6.1 Development of PQOs Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria Table	WS 11 WS 12(G)
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	 WS 13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	WS 14 WS 15(G) WS 16

Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/ SOP Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	WS 17 WS 18 WS 19(G) WS 20(G) WS 21(G) WS 22(G)
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	 WS 23(G) WS 24(G) WS 25(G)
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	 WS 26(G) WS 27(G)
3.4 Quality Control (QC) Samples 3.4.1 Sampling QC Samples 3.4.2 Analytical QC Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	WS 28(G)
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	WS 29(G) WS 30(G)
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	 WS 31(G) WS 32(G)
4.2 QA Management Reports	- QA Management Reports Table	WS 33(G)
4.3 Final Project Report		

Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	WS 34(G) WS 35(G) WS 36(G) WS 37(G)
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining		

QAPP Worksheet #3 (UFP-QAPP Manual Section 2.3.1) -- Distribution List

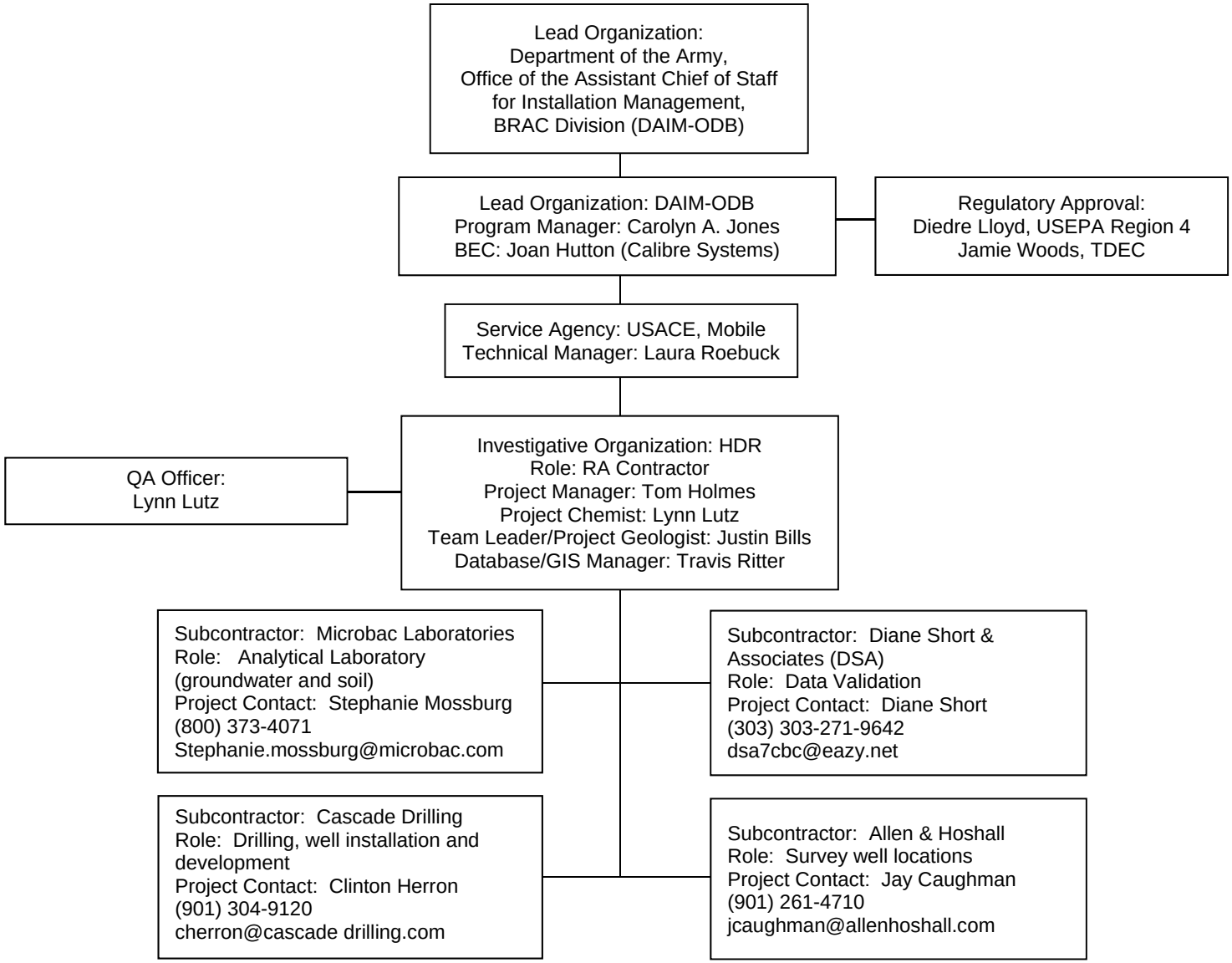
QAPP Recipients	Title	Organization	Telephone Number	E-mail Address	Control Number
Carolyn Jones	Program Manager	ACSIM ODB	(703) 545-2508	carolyn.a.jones28.civ@mail.mil	01
Joan Hutton	BRAC Environmental Coordinator	Calibre	(770) 317-4323	joan.hutton@calibresys.com	02
Laura Roebuck	USACE Technical Manager	USACE, Mobile	(251) 690-3480	laura.w.roebuck@usace.army.mil	03
Diedre Lloyd	USEPA Representative, Remedial Project Manager	USEPA Region 4	(404) 562-8855	lloyd.diedre@epa.gov	04
Jamie Woods	TDEC Representative, Remedial Project Manager	TDEC Division of Remediation	(901) 371-3041	jamie.woods@tn.gov	05
Tom Holmes	RA Project Manager	HDR	(404) 295-3279	thomas.holmes@hdrinc.com	06
Lynn Lutz	RA Project Chemist/ QA Manager	HDR	(303) 754-4200	lynn.lutz@hdrinc.com	07
Project File	--	HDR	(303) 754-4248	rebecca.miura@hdrinc.com	08

QAPP Worksheet #4 (UFP-QAPP Manual Section 2.3.2) – Project Personnel Sign-Off Sheet

Organization: _____

Project Personnel	Title	Telephone Number	QAPP Section(s)	Date QAPP Read	Signature

QAPP Worksheet #5 (UFP-QAPP Manual Section 2.4.1) -- Project Organizational Chart



QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) - Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Joan Hutton	BRAC Environmental Coordinator	CALIBRE	Oversees project and responds to EPA & TDEC	MS, Marine Science, 30 yrs. exp.
Glen Turney, PE	Program Manager	HDR	Manages restoration program; provides engineering and resource support	MBA, BS Chem Eng, 39 yrs. exp.
Tom Holmes, PG	Project Manager	HDR	Manages project and provides technical direction	MS Geophysics, 38 yrs. exp.
Lynn Lutz	Project Chemist/QA Manager	HDR	Coordinates analytical and data validation activities; oversees QA	BA Chemistry, 31 yrs. exp.
Justin Bills	Team Leader/Project Geologist	HDR	Manages field activities; oversees well installation and development	BS Earth Science, 7 yrs. exp.
Travis Ritter	Database/GIS Manager	HDR	Maintains project database; prepares tables and figures	MS Env. Science, 17 yrs. exp.
Daniel Sciarro, ASP	Health and Safety (H&S) Specialist	HDR	Oversees H&S for field activities	MS Occup Safety and Health, 12yrs exp.
Stephanie Mossburg	Analytical Project Manager	Microbac Laboratories	Manages groundwater analyses	BS Biochemistry, 25 yrs. exp.
Clint Herron	Drilling Project Manager	Cascade Drilling	Manages well installation	11 yrs. exp.
Diane Short	Validation Project Manager	Diane Short & Associates	Conducts independent analytical data validation	MS Chemistry and Molecular Genetics, 40 yrs. exp.

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) – Project Scoping Session Participants Sheet

Complete this worksheet for each project scoping session held. Identify project team members who are responsible for planning the project.

Project Name: SRI Phase 2 **Projected Date(s) of Sampling: September 2016** **Project Manager: HDR, Tom Holmes**	**Site Name: Main Installation, DDMT** **Site Location: Memphis, TN**
Date of Session: 21 April 2016 **Scoping Session Purpose: SRI Phase 1 Report Review and Phase 2 Scoping**	

Name	Role	Affiliation	Phone #	E-mail Address
Joan Hutton	BEC	Calibre	(770) 317-4323	joan.hutton@calibresys.com
Diedre Lloyd	RPM	USEPA, R4	(404) 562-8855	lloyd.diedre@epa.gov
Tom Holmes	PM	HDR	(404) 295-3279	thomas.holmes@hdrinc.com

Comments/Decisions: The scoping session was conducted as a follow-up to the April Site Management Team project review call; the purpose was to discuss the SRI Phase 1 report, currently in review by USEPA and TDEC, and the initial plans for Phase 2 of the SRI. Prior to the April call, Ms. Hutton provided a table listing plume delineation questions based on the Phase 1 results; the questions were identified as data quality objectives (DQOs). Figures with suggested well locations were also provided. Locations were recommended for 2 wells screened in the IAQ and 28 wells screened in the Fluvial Aquifer. Since funding for all the recommended wells is not currently available, the DQOs and well locations were reviewed to identify the highest priority DQOs and well locations. Based on that review, 1 IAQ well and 8 Fluvial Aquifer wells were recommended to be installed during Phase 2; additional wells will be installed in a later phase of investigation (SRI Phase 3, see Worksheet #10). Mr. Holmes reviewed the DQOs, the associated wells and the wells recommended for installation during Phase 2. Mr. Holmes and Ms. Hutton requested that Ms. Lloyd consider the following questions:

1) Does the table list the DQOs required to complete the groundwater investigation?

2) Are the number and location of proposed wells for each question appropriate?

3) Do the wells suggested for Phase 2 indicate the correct priorities?

An email summarizing the discussion was submitted to the participants and Jamie Woods of TDEC.

Project Name: SRI Phase 2 **Projected Date(s) of Sampling: September 2016** **Project Manager: HDR, Tom Holmes**			**Site Name: Main Installation, DDMT** **Site Location: Memphis, TN**	
Date of Session: 27 April 2016 **Scoping Session Purpose: SRI Phase 2 Scoping**				
Name	**Role**	**Affiliation**	**Phone #**	**E-mail Address**
Jamie Woods	RPM	TDEC	(901) 371-3041	jamie.woods@tn.gov
Tom Holmes	PM	HDR	(404) 295-3279	thomas.holmes@hdrinc.com

Comments/Decisions: Mr. Woods and Mr. Holmes had a telephone call to discuss Mr. Woods' review of the DQOs and proposed well locations. Mr. Woods did not have any additions to the DQOs. After discussion of proposed wells F-2 and F-3 near MW-270 and F-17 near MW-258, Mr. Woods stated he was in agreement with the proposed locations.

Action Items: HDR will submit the Phase 2 Work Plan with proposed well locations for review by USEPA and TDEC.

Consensus Decisions: USEPA and TDEC RPMs were in general agreement with the DQOs and the proposed well locations. Additional review and comment will be provided upon receipt of the work plan.

QAPP Worksheet #10 (UFP-QAPP Manual Section 2.5.2) - Problem Definition

Problem Definition:

The MI ROD selected EBT in the most contaminated areas, with concentrations in the untreated parts of the groundwater plume expected to decrease through natural attenuation. The MI ROD estimated that 10 years would be required for the selected remedy to meet RAOs. The MI RD used concentrations of 100 µg/L for PCE and TCE to delineate treatment areas. EBT was performed initially from September 2006 through March 2009. Additional EBT was performed from November 2012 through November 2014. The final report for additional EBT reported that 1) CVOC concentrations were decreased in the treatment areas by averages of 80% at injection wells (IWs) and 30% at performance monitoring wells (PMWs) and 2) the number of IWs and PMWs exceeding MCLs decreased from 55 wells in December 2011 to 17 wells in November 2014. However, 64 of 111 LTM/SRI wells sampled in October 2015 exceeded MCLs and the projection for RA completion at the MI in 2017 is not being met.

This SRI/FFS is being performed to develop a remedial strategy to achieve RAOs throughout the MI. Significant revisions to the site conceptual model have been made based on data generated during implementation of remedial actions, previous post-RI investigations and Phase 1 of the SRI. The additional data have shown a greater extent of CVOCs in groundwater and clarified groundwater flow on the MI.

The SRI Phase 1 report had the following findings:

- Water level data suggests a sink in the southeast MI and groundwater flow in the Fluvial Aquifer onto the MI from all directions. If confirmed, groundwater impacts on the MI would not affect off-site residents, and the remedial action should address reduction/prevention of impacts to deeper aquifers through vertical migration primarily through the window.
- Although 2009 groundwater modeling indicated attenuation was occurring, site conditions are not conducive to natural biodegradation of CVOCs and CVOC concentrations have generally not decreased outside EBT areas. The 100 µg/L criterion for active remediation is not considered sufficient to meet RAOs and will be re-considered during the FFS.
- Additional plume delineation is needed in several areas to confirm the extent, including upgradient and off-site locations.
- Phase 1 well MW-270 along the southern MI boundary identified groundwater contamination outside the designated plumes. There are other large areas of the MI which have not been investigated for groundwater impacts

Based on the Phase 1 results and 2015 LTM results, the following table was developed listing data gaps, and the number and general location for monitoring wells to address the data gaps. Since the available funding is not sufficient to fully address all the identified data gaps, the highest priority locations were identified and are listed as Phase 2 Wells; the remaining wells are listed as Suggested Wells for Later Investigation.

In addition to the remaining monitoring wells, other work may be required beyond Phase 2 including updates to previous risk assessment and groundwater modeling. The SRI needs to be completed with agreement from EPA and TDEC in order to develop a successful strategy for remedial action to meet the RAOs.

Data Gap	CVOC	Well Locations	Phase 2 Wells	Suggested Wells for Later Investigation
1. Offsite extent of CVOCs in IAQ	PCE, TCE	I-1: N of MW-256.	I-1 (MW-274)	-
2. Extent of CVOCs at MW-270	TCE	F-1 to F-4: Two wells on-site and two off-site	F-2 (MW-275), F-3 (MW-276)	F-1, F-4
3. Presence of sink in southeast MI	--	F-5: S boundary between MWs 24 & 93	F-5 (MW-277)	-
4. Potential impacts in IAQ from sink	PCE, TCE	I-2: Central area of sink, near MW-259	-	I-2
5. Extent of CVOCs upgradient & offsite of TTA-1N	PCE	F-6 to F-8: Upgradient and side-gradient of MW-269	F-6 (MW-278)	F-7, F-8
6. Extent of CVOCs upgradient of TTA-1S	PCE	F-9: Upgradient (WSW) of DR1-5/5A	F-9 (MW-279)	-
7. Extent of CVOCs upgradient of TTA-2W	PCE, TCE, CT	F-10 to F-12: Upgradient (N, NE) and side-gradient (ESE) of MW-267.	F-11 (MW-280)	F-10, F-12, F-13
		F-13: Screen in Fluvial Aq adjacent to MW-268.		
8. Extent of VOCs upgradient and side-gradient of N-C plume	PCE, TCE	F-14: Off-site NE of MW-263	F-17 (MW-281)	F-14, F-15, F-16
		F-15: Side gradient at mid-section of plume, E of MW-260		
		F-16 & F-17: side-gradient at downgradient extent of plume		
9. Additional FAQ wells to clarify groundwater gradient and presence of CVOCs in areas w/o previous investigation	--	F-18: North central MI upgradient of MW-107 (PCE)	F-18 (MW-282)	F-19, F-20
		F-19: Northeast MI		
		F-20: Central MI at N extent of suspected sink		
10. Extent of CVOCs upgradient of B835	TCE	F-21: Upgradient (NW) of MW-143. (F-21A was proposed location in Nov 2014 mtg with EPA)	-	F-21, F-22
		F-22: Upgradient of MW-62, between MW-257 and MW-62		
11. Extent of contamination in S-C plume	TCE	F-23: Upgradient of MW-97	-	F-23, F-24, F-25, F-26
		F-24: Downgradient of MW-97		
		F-25: S of MW-261 between MW-97 and PZ-03.		
		F-26: Between PZ-03 and MW-271		
12. Southeast MI	PCE, TCE	F-27: Upgradient of MW-52 and MW-270 (Proposed location in Nov 2014 mtg with EPA)	-	F-27

The locations of Phase 2 Wells and Suggested Wells for Later Investigation are shown on Figure 1 of the work plan. The Phase 2 Well Locations are shown on an aerial photo base in Figure 2. As noted on Worksheet #9, USEPA and TDEC RPMs were requested to review the data gaps, the suggested well locations and the wells to be installed during Phase 2.

An additional phase of investigation (SRI Phase 3) is planned to install the remaining wells in order to address all the identified data gaps. Pending approval of the scope and available funding, the additional wells are to be installed in early 2017.

Project Description:

Phase 2 of the SRI consists of installation of nine monitoring wells on and adjacent to the MI based on recommendations in the SRI Phase 1 Summary report and the 2015 Annual LTM report. The Phase 2 well locations were prioritized from the well locations recommended to address the data gaps for contaminant delineation and site hydrogeology listed above within the current statement of work and funding.

Following installation and initial sampling, the Phase 2 wells will be incorporated in LTM.

The project tasks are summarized on WS #14.

Project Decision Conditions:

The Phase 2 SRI work plan was prepared to address the highest priority data gaps. The FFS and decision document will not be prepared until the additional monitoring wells are installed in SRI Phase 3 and risk assessment and groundwater modeling updates are completed.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) – Project Quality Objectives/Systematic Planning Process Statements

Who will use the data? HDR, U.S Army, U.S. EPA, TDEC, USACE-Mobile.

What will the data be used for? HDR will use the data to prepare groundwater elevation contour and top of clay maps for a better understanding of site hydrogeology and CVOC concentration maps to confirm extent of groundwater plumes in the fluvial and intermediate aquifer. The data will be used to improve site hydrogeological model and to develop remedial alternatives for the FFS.

What type of data are needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques) Continuous soil cores will be collected in each boring and soil types will be identified in accordance with the Unified Soil Classification System (USCS). Soil sampling for geotechnical or analytical analyses is not planned. Soils will be screened visually and with a photo-ionization detector for contaminants; samples will be collected for VOC analysis if contamination is suspected.

Groundwater samples will be collected for analysis following well development. Samples will be collected by low flow purging with bladder pumps; bailers will be used where saturated thickness or recharge is limited. Groundwater levels will be collected at new wells; field parameters (specific conductivity, temperature, pH, dissolved oxygen, oxidation reduction potential and turbidity) will be measured prior to sampling. Groundwater sample analyses at off-site laboratories will be limited to VOC analysis by SW-846 Method 5030B/8260B. Following sampling, tethers with passive diffusion bags will be installed where saturated thickness in the well exceeds 5 feet.

Samples of soil and water IDW will be collected to determine disposal requirements. Soil samples will be analyzed for VOCs by standard analysis (SW-846 Method 5035B/8260B) and by toxicity characteristic leaching procedure (TCLP) analysis (SW-846 Method 1311 [TCLP extraction] followed by 5030B/8260B). Water samples will be analyzed for full TCLP analysis (SW-846 Method 1311 followed by 6010C/6020A [metals], 7470A [mercury], 8081A [pesticides], 8270D [SVOCs], and 8260B [VOCs]).

How "good" do the data need to be in order to support environmental decisions? Field measurements during groundwater sampling provide screening level data that are sufficient to determine that water quality has stabilized for sample collection and to evaluate aquifer conditions. Definitive data will be provided by laboratory analyses.

How much data are needed? (number of samples for each analytical group, matrix, and concentration) Hydrogeological and analytical data will be collected at the 9 new wells. The findings will be combined with historical data from the 12 SRI Phase 1 wells, the 99 MI LTM wells and the 28 EBT monitoring wells.

Where, when, and how should the data be collected/generated? The new well locations are shown on Figure 1 with groundwater contours and isopleths for PCE and TCE concentrations from the October 2015 LTM event. Following initial sampling, the new wells will be sampled during semiannual LTM events until a sample frequency is determined in accordance with the MI LTM Plan.

Who will collect and generate the data? HDR and subcontract laboratory, Microbac (groundwater samples).

How will the data be reported? The laboratory will provide a Level 4 report for the SRI groundwater samples. The complete analytical results with final DQE flags will provided in the SRI report with accompanying data validation reports.

How will the data be archived? All project deliverables, including analytical reports, are electronically archived for 10 years following project completion. The final SRI report will be included in the DDMT Administrative Record and will be stored permanently through the National Archives and Records Administration.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) – Secondary Data Criteria and Limitations Table

Secondary Data Source (Originating Organization, Report Title, and Date)	Data Types	How Data Will Be Used
USEPA. *Groundwater Remedy Completion Strategy*, OSWER 9200.2-144. May 2014	Current guidance.	To plan Phase 2 Investigation and report content.
HDR. *Supplemental Remedial Investigation Phase 1 Summary Report, Defense Depot Memphis, Tennessee*. February 2016.	Site history, review of past investigations/feasibility studies, groundwater modeling and hydrogeological and analytical results.	To plan Phase 2 investigation and as basis of final report.
HDR. *Annual Long-Term Monitoring Report-2015, Defense Depot Memphis, Tennessee*. May 2016. (In preparation)	Recent hydrogeological and analytical results.	Recent analytical data to plan Phase 2 investigation and interpret results.

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) – Summary of Project Tasks

Well Installation:

Access for well locations on the MI will be cleared with the property manager and tenants/owners; access for off-site locations will be obtained from the property owners. Permits for well installation will be obtained from Shelby County Health Department. Proposed well locations will be cleared for utilities prior to drilling.

Borings for Fluvial Aquifer wells will be advanced by rotasonic drilling to the uppermost clay beneath the water table. Each boring will be backfilled to the top of clay and the well installed using Schedule 40 polyvinyl chloride (PVC) casing and screen.

Boring for IAQ well will be advanced by rotasonic drilling 5-10 feet into the clay at the base of the Fluvial Aquifer. Surface casing will be installed to the bottom of the boring and grouted in place; boring will then be advanced to the target depth and the well installed using Schedule 80 PVC casing and screen.

Wells will be developed no sooner than 24 hours after completion.

Soil cuttings from all well borings will be contained in a roll-off or on plastic sheeting for testing prior to disposal. Cuttings with suspected contamination due to elevated photoionization detector (PID) readings or visible staining will be segregated. Wastewater generated during drilling, well installation and development will be contained for sampling and analysis to determine disposal requirements.

Horizontal and vertical coordinates for each new well will be determined by licensed surveyor after installation.

Project-specific requirements for well installation are provided in the attachment to this worksheet.

Sampling:

Following installation of all Phase 2 wells, water level measurements will be collected at Phase 2 wells and nearby LTM and EBT wells during a 1-day sweep. Measurements will be collected before, or at least 24 hours after, groundwater sampling.

Collect groundwater samples using bladder pumps for low-flow sampling; if the saturated thickness or recharge is insufficient for a bladder pump, samples will be collected using dedicated bailers. Water quality parameters will be measured to confirm well stabilization prior to sampling.

Collect samples from IDW (soil cuttings and waste water) to determine disposal requirements. Additional samples will be collected from cuttings with suspected contamination.

Analysis:

Analyze groundwater samples for VOCs. Analyze soil IDW samples for VOCs by standard analysis and TCLP. Analyze wastewater samples for full TCLP analysis.

Quality Control:

Follow SOP 1-Drilling and Soil Sampling; SOP 2-Well Installation, Development and Abandonment; SOP 4-Groundwater Sample Collection; SOP 7- Sample Control and Documentation; and SOP 8-Sample Packing and Shipping. Field QC samples are described on Worksheet #20-Field Quality Control Sample Summary Table and laboratory QC samples on Worksheet #28-QC Samples Table.

Secondary Data:

Not applicable.

Data Management:

Laboratory will provide complete analytical data package including raw data (Level 4) for groundwater samples in accordance with Appendix E, SW-846 Reporting Requirements, of the Department of Defense (DoD) Quality Systems Manual Version 5.0 (July 2013).

Analytical data will be added to DDMT database after validation.

Documentation and Records:

All well locations will have final coordinates documented with surveyor stamped plats. Field measurements and sample data will be noted in field records and maintained in project files. The stamped plats and field records will be provided in appendices to the SRI report.

Groundwater sample analytical results will be provided in summary tables for analytes detected and in tables showing complete analytical results in an appendix. The complete laboratory analytical reports and data validation will also be provided in appendices to the SRI report.

Assessment/Audit Tasks:

Field sampling procedures are reviewed in annual audits by QA officer.

Annual laboratory audits are performed through NELAP.

Data Review Tasks:

Laboratories will verify that data are complete for samples received. All data package deliverables requirements will be met. Data will be reviewed by Diane Short & Associates at the Step I (Verification)/Steps IIa and IIb (Validation) level as described in the Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual. Final validation qualifiers will be applied as described in section 4.2.2 and detailed in Table 7. Achievement of project-specific measurement performance criteria (MPC) specified in the QAPP and data validation criteria (DVC) will be evaluated during the data verification and validation, and the analytical measurement error will be assessed. A Steps I/IIa/IIb Data Validation Report will be produced for each Sample Delivery Group.

Validated data and related field logs/notes/records will be reviewed to assess total measurement error and determine overall usability of the data for project purposes. Data limitations will be determined and data will be compared to PQOs and required Action Limits. Corrective action is initiated, as necessary. Final data are placed in a database, with any necessary qualifiers, and tables, charts, and graphs are generated.

ATTACHMENT - **WELL INSTALLATION**

Borings will be advanced using rotasonic drilling methods and continuous soil cores will be collected from ground surface to the termination depth of each boring. Drilling and well installation will be performed by Cascade Drilling, a licensed Tennessee well driller. An HDR field geologist will record field observations and log the soil core. Headspace analysis with a PID will be made on one grab sample selected from each 10-foot soil core based on field observations; the PID reading will be recorded on the boring log.

Fluvial Aquifer Wells

A 6-inch borehole will be advanced up to 5 feet into the uppermost clay beneath the water table. After presence of the clay is confirmed, the boring will be back-filled with bentonite pellets to just below the top of clay.

Well casings will be new, unused, decontaminated, 10-foot sections of 2-inch I.D. Schedule 40 PVC pipe with internal flush, threaded joints.

Well screens will be one 10-foot section of Schedule 40 PVC continuous slotted 0.010-inch screen; the screen length will not exceed 10 feet. A threaded PVC cap or point will be placed at the bottom of the screen. Centralizers will be used at the top of the screened section, and every 30 feet along the riser.

A filter pack of clean, inert, hard, well-rounded coarse sand (8-16 or 10-20 sieve with less than 2 percent flat particles) will be installed from approximately 1 foot below to 5 feet above the well screen. A minimum 5-foot-thick bentonite seal will be placed above the filter pack. Cement-bentonite grout will be placed in the annular space above the bentonite seal to approximately 6 inches bgs.

Wells will generally be set as flush-mounted completions with brightly painted bollards used where appropriate. Stick-up well completions with a metal outer casing and up to four brightly painted bollards will be used to protect the well. The number and location of bollards required at each well will be determined by the Field Team Leader. Each well pad will be 3 by 3 foot square and 4 inches thick constructed using Quikcrete® crack resistant (No. 1006) or equivalent concrete mix. The manhole will be a Morrison Bros. Co. 519 9-inch diameter powder-coated single-bolt water tight manhole (or equivalent) placed in the center of the pad and approximately 1-inch higher than the edge of the pad. The manhole will have an identification brass label stamped to clearly show the well ID. Wells will be secured as soon as possible after drilling with corrosion resistant locks.

The wells will be developed with a surge block in conjunction with a pump. Well development will be initiated no sooner than 24 hours following grout installation. Development will continue until clear, sand-free formation water is produced from the well and until pH, conductivity, turbidity, and temperature measurements have stabilized. Stabilization is defined when the pH is within + or - 0.1, the conductivity is + or - 5 %, and the turbidity is less than 10 NTUs. Four Phase 1 wells (MW-263, MW-264, MW-265 and MW-266) did not meet stabilization criteria in the initial development or sampling and will be redeveloped.

Intermediate Aquifer Wells

A 12-inch borehole will be advanced 5 to10 feet into the uppermost clay at the top of the Jackson Formation/Upper Claiborne Group (base of fluvial aquifer). An 8-inch diameter, threaded Schedule 80 PVC or steel surface casing will be installed. After placing the surface casing, the driller will lower a tremie pipe connected to a grout pumping unit through the inner annulus of the casing. The driller will pump grout through the injection pipe until the grout returns to the ground surface. The grout will cure for 24 hours before continuing to advance the borehole. Water present in the inner annulus of the casing will be pumped to a holding tank before the borehole is advanced to the target depth.

Well casings will be new, unused, 2-inch I.D. Schedule 80 PVC pipe with internal flush, threaded joints. The well screens will be one 10-foot section of new, unused, 2-inch I.D. Schedule 80 PVC continuous slotted 0.010-inch screen. A threaded PVC cap or point will be placed at the bottom of the screen. Centralizers will be used at the top of the screened section and every 30 feet along the riser. The well casing, screen, cap and centralizers will be decontaminated prior to use.

A filter pack of clean, inert, hard, well-rounded sand (less than 2 percent flat particles) will be installed from approximately 1 foot below to 5 feet above the top of the well screen. The filter pack material will be selected based on the soil type in the zone to be screened; coarse sand (10-20 sieve) or medium sand (20-40 sieve) will be used. The bentonite seal, cement-bentonite grouting, surface completion and well development for IAQ wells will be as described for fluvial aquifer wells.

Investigation Derived Waste

Waste generated during SRI Phase 2 activities will be classified as either non-investigative waste or investigation-derived waste (IDW). Non-investigative waste, such as packaging materials, personal protective equipment, disposable sampling supplies, debris from well pads and manholes, and other inert refuse, will be collected and placed in the collection bin at the HDR field office for disposal at a municipal landfill. The IDW consisting of soil cuttings from the borings, waste water from equipment decontamination and groundwater from well development

will be stored for analysis prior to disposal.

Soil cuttings from the well borings will be transported to Dunn Field and placed on plastic sheeting; the cuttings will be covered by plastic sheeting held in place by perimeter weights. Grab samples will be collected from the soil cuttings for analysis of VOCs by standard (8260) analysis and by TCLP. If standard analysis demonstrates the VOC concentrations are less than the Dunn Field remediation goals (RGs), the soil cuttings will be spread on Dunn Field. If the soil concentrations exceed the RGs, TCLP VOC results will be reviewed to confirm the soil meets requirements for disposal as non-hazardous waste at a CERCLA-approved facility in the Memphis area.

Water IDW will be stored in a Baker frac tank with a non-hazardous waste label; the water source (equipment decon and well development) and the start/end dates will be listed on the label. The tank will be on-site at a location to be determined during mobilization and will be properly labeled. After well installation, development and sampling is completed, grab samples of wastewater will be collected for complete TCLP analysis and disposal as non-hazardous waste at a CERCLA-approved facility in the Memphis area.

QAPP Worksheet #16 (UFP-QAPP Manual Section 2.8.2) - Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date[1]
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
SRI Phase 2 Work Plan	HDR	4/4/16	6/3/16	Rev. 0 Work Plan	3/25/16
Well Access Agreement	HDR	5/16/16	7/29/16	Final agreements	-
Phase 2 Well Installation And Development	HDR/Cascade	9/19/16	10/7/16	Field reports, boring logs and well diagrams to file	-
Well Sampling	HDR	10/10/16	10/14/16	Samples to laboratory, field reports to file	-
Phase 2 Sample Analysis	Microbac-CTL	10/17/16	11/4/16	Level 4 report and Electronic Data Deliverable (EDD)	-
Data Validation	DSA	11/7/16	11/11/16	Data narrative report	-
Report Preparation	HDR	10/17/16	1/27/17	SRI Report Rev. 0	10/27/16

Note:

1) Deliverable Due Dates for the SRI Phase 2 Work Plan, Rev.0 and the SRI Report, Rev. 0 are from the 2016 Site Management Plan, Rev.1 (HDR, 2016). Anticipated Dates of Completion were extended due to additional time required for SRI Phase 1 Report submittal and review.

2) Report preparation will include SRI Phase 2 activities only. The final SRI report will be prepared upon completion of the SRI Phase 3 investigation and updates to the risk assessment and groundwater model (see Worksheet #10, Project Decision Conditions); the schedule will be provided in the SRI Phase 3 Work Plan.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) - Sampling Design and Rationale

Rationale for sampling approach:
Groundwater Samples

- Well locations were selected based on review of analytical results and groundwater elevation contours from October 2015 LTM, which included SRI Phase 1 wells. Isopleths for primary contaminants (PCE and TCE), groundwater contours and proposed locations are shown on Figure 1. The proposed locations are shown on an aerial photo base on Figure 2.
- The depths for Fluvial Aquifer wells (MW-275 to MW-282) were estimated based on elevations for groundwater and the top of clay in nearby wells, and the depth for the IAQ well (MW-274) was estimated from existing wells MW-256 and MW-262.
- The horizontal coordinates for the proposed wells, estimated depths to groundwater and the top of clay, and estimated total depths for surface casing, screen interval, well and boring are listed on Table 1.
- The objective for each well is listed below:
  - I-1 (MW-274) – north-northwest of MW-256 to delineate off-site extent of contamination and determine groundwater gradient for the IAQ in the northwestern area of the MI; off-site location.
  - F-2 (MW-275) – east-southeast of MW-270 to investigate extent of TCE and cis-1,2-dichloroethene (cDCE) concentrations and groundwater gradient; off-site location.
  - F-3 (MW-276) – west-northwest of MW-270 to investigate extent of TCE and cDCE concentrations and groundwater gradient.
  - F-5 (MW-277) – near southern boundary south of MW-272 to investigate presence of sink in south-central MI.
  - F-6 (MW-2786) – west of MW-269 to investigate upgradient extent of Target Treatment Area (TTA)-1N plume; off-site location.
  - F-9 (MW-279) – southwest of DR1-5/5A to investigate upgradient extent of TTA-1S plume.
  - F-11 (MW-280) – northeast of MW-267 to investigate upgradient extent of TTA-2 West plume.
  - F-17 (MW-281) – west of MW-258 to investigate extent of North-Central plume and potential impacts to the IAQ.
  - F-18 (MW-282) – north of MW-281 in area with limited groundwater data to investigate potential sources upgradient of MW-107 and potential impacts to the IAQ.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) - Sampling Locations and Methods/SOP Requirements Table

Sampling Location	Number of Locations	Matrix	Depth (feet)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]	Rationale for Sampling Location
SRI Phase 2 Fluvial Aquifer Wells	8	GW	69 - 96	VOCs	Low-Moderate	9 field, 1 duplicate	SOP 4	Determination of groundwater flow and contaminant extent
SRI Phase 2 IAQ Wells	1	GW	140		Low		SOP 4	Determination of groundwater flow and contaminant extent

[1]Specify the appropriate letter or number from the Project Sampling SOP References table (Worksheet #21).

APPENDIX C
PROJECT-SPECIFIC HDR STANDARD OPERATING PROCEDURES

SOP 1 – General Procedures for Field Personnel

SOP 2 – Drilling and Soil Sampling

SOP 3 – Well Installation, Development and Abandonment

SOP 4 – Groundwater Sample Collection

SOP 7 – Sample Control and Documentation

SOP 8 – Sample Packing and Shipping

SOP 9 – Equipment Decontamination

SOP 10 – Data Verification, Validation, Qualification and Usability Assessment

STANDARD OPERATING PROCEDURE 1 - GENERAL PROCEDURES FOR FIELD PERSONNEL

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Justin Bills
Project QA Officer: Lynn Lutz
Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for the general field practices to be followed during field activities at Defense Depot Memphis, Tennessee (DDMT); review is mandatory prior to the start of each field event. This SOP provides general guidance; the project-specific work plan must be reviewed for specific project requirements.

2.0 HEALTH AND SAFETY

Each individual assigned to field work must participate in the HDR Medical Monitoring Program, must have taken the Occupational Safety and Health Administration (OSHA) 40-Hour course (updated with the 8-Hour OSHA Refresher, when necessary), and must be certified as able to wear respiratory protection.

Each individual is required to have read and understood the Health and Safety Plan (HASP) for the specific project activity. Upon arrival at the site, each person shall sign the acknowledgement sheet confirming their review of the HASP. Personal protective equipment (PPE) and other provisions for site safety requirements are discussed in the project specific Health and Safety plan.

All equipment will only be used by properly trained personnel. In particular, evaluation and repair of remediation systems (air sparge and soil vapor extraction) will only be performed by personnel familiar with the systems. Only personnel that have received forklift operator safety training are permitted to use the forklift. Proper tools will be made available to each employee as necessary. Any questions should be addressed to the Field Team Leader (FTL).

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Field activities will be directed by the FTL, a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in performing and directing the planned activities. Field staff will be junior to mid-level environmental professionals or environmental technicians. Field work will be

conducted by persons with experience in performing the planned activities. At least one person on each team will have a current certification in first aid and CPR.

The FTL will provide direction to field staff to ensure work is performed in accordance with the project documents (Quality Assurance Project Plan [QAPP], project work plan and SOPs). The field staff will carefully review the project documents, conduct the work as planned, seek direction from the FTL when questions or problems arise, and carefully complete field documentation.

4.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will be identified in the SOPs for the specific field activities to be performed and in the project work plan. Field activities should not proceed until the proper tools and equipment are available and in good working order.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance. For each HDR owned vehicle, mileage will be recorded on the vehicle mileage log at the start and end of each field event.

5.0 PROCEDURE

5.1 Start-Up Activities

5.1.1 Office

Prior to leaving the office for field work, personnel will perform the following actions:

1. The Project Manager (PM) will assign an FTL to direct field activities and coordinate with project personnel. Task specific responsibilities of the FTL will be addressed in the appropriate SOP; general responsibilities include;
    - Review project work plan, HASP, and QAPP.
    - Work with PM to properly staff the field activity.
    - Coordinate sampling activities with the project chemist and analytical laboratory.
    - Confirm availability and condition of DDMT-owned equipment and order additional equipment/supplies for delivery prior to the start of each event.
    - Prepare field forms and other documentation for the planned event.

- If work is to be subcontracted, review the subcontract agreement, work plan, and HASP.
- Confirm that field staff have Driver's License (or other picture identification) and current OSHA Certification in their possession prior to leaving the office.
- Confirm permits required for field activities, if any, will be received prior to mobilization.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify materials for field activities are on site.
- Confirm that required permits and subcontractor documentation have been received.
- Review condition of DDMT-owned and rental equipment; inventory field supplies and laboratory-provided sampling supplies.
- Review locations for planned field activities for hazards, determine requirements for site preparation and clearance, and select location for the storage of purge and decontamination waters.
- Conduct team safety meetings as required by the HASP.
- Conduct team review of the project documents including SOPs to be utilized.
- Complete the Field Event Startup Report and submit to PM (Attachment 1-1).

5.2 Field Operations

Field staff responsibilities are project-specific. At a minimum, field personnel will perform the following activities:

1. Document field activities in a log book for each team and/or field records as required by the work plan or SOPs.
2. Record the following additional information for field measurements:
   - The identification number and calibration results for each field instrument
   - The numerical value and units of each measurement
   - A description of any unexpected delays or problems observed during purging or sampling activities

3. Complete required data collection/sample control forms (e.g., Chain-of-Custody, Field Sampling Report, etc.).
4. Communicate with the PM regarding site conditions and out of scope work to be performed.
5. Perform following activities daily before leaving the site:
    - Decontaminate and check condition of field equipment.
    - Provide log books and other field documentation to FTL for review and scanning.
    - Properly dispose of trash, debris and used PPE.
    - Safely store purge and decontamination water, or transfer to large storage tanks at Dunn Field.
    - Make arrangements for shipment of samples (if applicable) and follow-up with the analytical laboratory to confirm samples arrived in good condition.
    - Complete activity-specific field reports as required by applicable SOPs.
    - Complete the Daily Field Report and submit to PM (Attachment 1-2).

5.3 Field Log Books and Documentation

1. Dedicated log books will be used by each field team in addition to documentation required by activity-specific SOPs.
    - The first page of each log book will list the following information:
        - Site Name: Former Defense Depot Memphis Tennessee
        - EPA ID (TN4210020570)
        - Project Location: 2241 Truitt Street, Memphis, TN 38114
    - The first entry for each field event will list the following information: log books:
        - Project Name and Number
        - FTL (full name) and initials
        - Sample team leader and members (full names) and initials
    - At minimum, the log book will describe general activities performed, date and time, personnel and weather conditions. All field equipment calibration and maintenance records will be documented in the logbook. Communications with the FTL, PM or project chemist

regarding field activities will be documented. Additional field data will be recorded in the log book if other field records are not used.

- Any deviations from the QAPP or workplan will be noted in the log books.
- Errors will be crossed out with a single line, the correction added and the entry initialed.
- Each page will be numbered and dated. A diagonal line will be drawn through any unused portion of a page containing an entry. To indicate the end of an entry, personnel are required to initial and date the page at the conclusion of each day.

5.4 Closeout

Upon the completion of field activities, the FTL will view each site to verify the area has been cleared and restored as closely as possible to its prior condition. Trash will be removed from the site, and surface damage, including ruts caused by vehicles, will be repaired.

Confirm all equipment is accounted for and properly decontaminated and in good working condition. Notify PM if repairs are needed. Properly package and ship all rental equipment to the vendor. When shipping equipment, use the proper HDR FedEx number and insure the package for the cost of the equipment. Follow manufacturer's instructions on long and short term storage when storing government and/or HDR equipment.

Rental trucks should be fueled and returned to the rental company as soon as possible. HDR leased trucks should also be fueled and cleaned prior to storing at the shop.

Work areas should be cleaned with tools and equipment properly stored.

The FTL will make a final check of all logbooks and other field records to ensure there are no blanks or missing data and the entries are legible. FTL will organize scanned forms in proper order and transmit to PM.

The FTL will complete Field Event Closeout Report and submit to PM (Attachment 1-3).

6.0 DATA AND RECORDS MANAGEMENT

All field forms and log book entries will be scanned and copied to the project folder on the HDR network file share drive within one week of the field event completion. All photographs taken during the field event will be uploaded along with a typed photograph log (date, project and subject) to the HDR network file share drive. The photographs will then be erased from the camera. All original forms will be stored on

site in Memphis in the filing cabinet in the proper folder labeled for the project. The PM, project chemist and project administrator will be sent a link for the data.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

All work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs. All field activities will be recorded in the log books in sufficient detail to reconstruct the events. No erasures or mark outs will be made on field forms or log books. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8.0 REFERENCES

MACTEC *RA SAP Volume I: Field Sampling Plan, Defense Depot Memphis, Tennessee, Revision 1*, *WTP-1 General Procedures for Field Personnel*. November, 2005.

USEPA Region 4 SESD Guidance, *Soil Sampling* (SESDPROC-010-4). October, 2010.

Attachment 1-1

Field Event Startup Report

Prepared by: Date:

Event Name:

Project-Activity Number:

Summary of Planned Event:

Planned Performance Period: _____to_____

Project Documents - Title, Date

Work Plan:

Health and Safety Plan:

Other SOPs – List number/revision and title:

Field Event Staffing

Position	Name	OSHA Cert. (Y/N)	First Aid/ CPR (Y/N)	Driver's License (Y/N)	Proj. Plans reviewed (Y/N)	Experience (Hi-Med-Low-None)
Field Team Leader						

DDMT Field Equipment

Name/Use	Mfr./Model No.	Condition	Calibration Req'd.(Y/N)	Calibration supplies	Other supplies (batteries, etc.)

Attachment 1-1

Rental Equipment

Name/Use	Mfr./Model No.	Condition	Calibration Req'd.(Y/N)	Calibration supplies	Other supplies (batteries, etc.)

Lab-provided Sampling Supplies

Sample Type	Number	Supplies

Additional Tools/Supplies

Camera
Field forms (list):
Sample supplies (list):
Water/Ice cooler
Sample cooler

Attachment 1-1

Final Check

1. All required equipment/tools received and condition checked

Yes ___ No ___ Comment:

2. Initial equipment calibration completed

Yes ___ No ___ Comment:

3. Vehicles inspected

Yes ___ No ___ Comment:

4. Field locations reviewed

Yes ___ No ___ Comment:

5. Weather forecast checked

Yes ___ No ___ Comment:

6. Staff documents (OSHA, DL) checked

Yes ___ No ___ Comment:

7. Review of project plans confirmed and activities discussed

Yes ___ No ___ Comment:

8. Initial Safety Meeting held and HASP signed

Yes ___ No ___ Comment:

Attachment 1-2

Daily Field Report

Project Number/Activity:	**Date:**
Project Name:	**Field Team Leader:**
Brief Work Description:	

Weather:	**Temp:**

Previous Day's Samples received at laboratory – Y / N Comment:

Time	Description

Name/Organization of Field Staff, Subcontractors and Site Visitors	

Samples Collected

Problems or Deviations from Work Plan

Tasks to be completed next workday

_____ _____ _____

Name **Signature** **Date**

Attachment 1-3

Field Event Close-Out Report

Prepared by: Date:

Event Name:

Project-Activity Number:

Performance Period: _____to_____

Field Team Leader:

Field Staff:

Summary of Completed Event:

Field problems and/or changes from planned activities:

Change in number/type of samples collected:

Health and Safety problems/Injuries:

Attachment 1-3

Close-out Checklist

1. Log book and field forms scanned and originals placed in project file

Yes ___ No ___ Comment:

2. Equipment/tools decontaminated

Yes ___ No ___ Comment:

3. Rental equipment shipped to supplier

Yes ___ No ___ Comment:

4. Rental vehicles returned

Yes ___ No ___ Comment:

5. DDMT equipment and tools properly stored

Yes ___ No ___ Comment:

6. List damaged equipment

Yes ___ No ___ Comment:

7. Replacement supplies ordered

Yes ___ No ___ Comment:

8. Field locations inspected and trash/debris removed

Yes ___ No ___ Comment:

9. Field shop/office cleaned

Yes ___ No ___ Comment:

STANDARD OPERATING PROCEDURE 2 – DRILLING AND SOIL SAMPLING

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Justin Bills
Project QA Officer: Lynn Lutz
Project Manager: Tom Holmes

1 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for drilling and soil sampling operations in support of investigative activities at Defense Depot Memphis, Tennessee (DDMT). Drilling activities will enable collection of subsurface soil samples and allow the installation of monitoring wells. This SOP provides general guidance; the project-specific work plan must be reviewed for specific project requirements.

2 OVERVIEW

There are several methods by which drilling operations may be conducted including, manual (hand) augering, power augering with hollow-stem augers, sonic drilling, and cable tool or mud rotary drilling with installation of surface casing. Generally, hand augering is useful only for surficial soil sampling while the other methods are used for deeper, subsurface investigations, sampling and installation of monitoring wells. Sonic drilling is the recommended drilling method at DDMT; it has proven to be the most effective method for boring advancement and well installation based on the depth to water (i.e. 75-105 feet below ground surface [ft bgs]) and geologic characteristics of the fluvial aquifer (i.e. tight sands mixed with gravel up to cobble size).

Drilling activities that require the use of a truck-mounted drill rig will be conducted by a Tennessee-licensed subcontractor with experience on similar projects. The drilling subcontractor will advance boring to the target depth using the selected drilling technology and provide equipment sufficient to carry out the work as specified. Drilling and soil sampling will be overseen by the field team leader (FTL), a qualified geologist/engineer, with support staff if required. HDR personnel will prepare soil boring logs with lithologic descriptions and observations relevant to investigative activities, collect soil samples for field or laboratory analysis and monitor compliance with the site-specific Health and Safety Plan (HASP).

3 HEALTH AND SAFETY

Proper safety precautions must be observed during drilling activities and when collecting soil samples in accordance with the HASP. Each individual assigned to field work must: (1) participate in the HDR Medical Monitoring Program, or subcontractor medical surveillance program, as applicable, (2) must have taken the Occupational Safety and Health Administration (OSHA) 40-Hour course (updated with the 8-Hour OSHA Refresher, when necessary), and (3) must be certified as able to wear respiratory protection.

Each individual is required to have read and understood the HASP for the specific project activity. Upon arrival at the site, each person shall sign the acknowledgement sheet confirming their review of the HASP. Personal protective equipment (PPE) and other provisions for site safety requirements are discussed in the HASP. At a minimum for drilling all personnel will wear a hard hat, steel toe shoes, safety glasses, hearing protection, and a high visibility outer garment.

All equipment will only be used by properly trained personnel. In particular, the use of a photoionization detector (PID) will only be performed by personnel familiar with the equipment. Proper tools will be made available to each employee as necessary. Any questions should be addressed to the FTL.

All drilling locations will be cleared for underground and above ground utilities prior to beginning drilling activities. Prior to setting up on the drilling location, the FTL will confirm the location has been cleared with the appropriate utility companies and the property owner/tenant. Drilling will only proceed where no aboveground or subsurface obstructions exist. Locations will be offset if these obstructions are identified prior to drilling, or encountered after drilling has begun. The new locations will be as close as possible to the originally proposed locations; utility clearance will be performed again as necessary.

If drilling is to occur in the vicinity of overhead utilities, HDR personnel will measure utility line height from the ground surface using a clinometer (or similar device) to ensure a minimum safe clearance distance is maintained between on-site equipment and overhead utility lines. As needed, the appropriate utility company will be contacted in order to determine a recommended safe clearance distance from all aboveground or underground on-site utilities.

Prior to the start of drilling activities, the drilling subcontractor will hand auger at each drilling location to a depth of 4 ft bgs, in order to verify that no underground utilities or objects are present.

4 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Field activities will be directed by the FTL, a mid- or senior level engineer/geologist with experience in the planned drilling activities; junior to mid-level geologists will assist, if necessary. Field activities will be overseen by a Tennessee-licensed geologist or engineer. Drilling will be conducted by a licensed driller and crew familiar with planned activities, the project-specific work plan and HASP. At least one person on each team will have a current certification in first aid and CPR. Operation of fork lifts on site will be limited to personnel that have documentation for forklift operator safety training.

The FTL will provide direction to field staff to ensure work is performed in accordance with the project documents (Quality Assurance Project Plan [QAPP], project-specific work plan, HASP, and SOPs). The field staff will carefully review the project documents, conduct the work as planned, seek direction from the FTL when questions or problems arise, and carefully complete field documentation.

5 EQUIPMENT AND SUPPLIES

The required equipment and supplies will be identified in the project-specific work plan. Field activities should not proceed until the proper tools and equipment are available and in good working order. Usual equipment/supplies for a drilling project will include: a PID, tape measure, Munsell color chart, knife, nitrile gloves, field drill log forms, camera, and work table.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.

6 PROCEDURES

6.1 Start-Up Activities

6.1.1 Office

Prior to leaving the office for field work, personnel will perform the following actions:

1. The Project Manager (PM) will assign a FTL to direct field activities and coordinate with project personnel. Task specific responsibilities of the FTL will be addressed in the appropriate SOP; general responsibilities include:

    - Review project-specific work plan, HASP, QAPP, and for subcontracted work, review of the subcontract agreement.

- Work with PM to properly staff the field activity.
- Arrange site access with the property manager (Colliers International-Memphis Depot Industrial Park), tenants and/or property owners.
- Have a surveyor locate all of the proposed drilling locations, and mark each location with a wooden stake and white flagging or white paint.
- Notify the Tennessee One Call underground utility location and, if necessary, a private utility location service.
- Provide drilling subcontractor with proposed boring location and depth for well permits from Shelby County Health Department (SCHD); confirm receipt of permits.
- Coordinate sampling activities and supplies with the project chemist and analytical laboratory.
- Confirm availability and condition of DDMT-owned equipment and order additional equipment/supplies for delivery prior to the start of each event.
- Prepare field forms and other documentation for the planned event.
- Provide all HDR and subcontracted field personnel with time and location for personnel to meet prior to beginning field activities.
- Confirm that field staff have a valid Driver's License (or other picture identification) and current OSHA Certification in their possession prior to leaving the office.

6.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for drilling and soil sampling activities are on site.
- Notify SCHD prior to start of drilling activities in accordance with permit requirements.
- Review condition of DDMT-owned and rental equipment; inventory field supplies and laboratory-provided sampling supplies.
- Confirm drilling and soil sampling locations are clearly marked and review locations for hazards; determine if the utility locators have adequately marked utilities on the site. Check for overhead

dangers such as power lines, and make necessary height measurements to ensure safe clearance distances are maintained.

- Determine requirements for site preparation and clearance, and select location for the placement of the decontamination area, storage of decontamination waters, and soil cuttings.
- Confirm locations and requirements for each sample to be collected.
- Conduct site set up activities to include posting of signage (if applicable) and delineation of work zones as required in the HASP.
- Calibrate field equipment.
- Conduct team safety meetings as required by the HASP.
- Conduct team review of the project documents including SOPs to be utilized.
- Complete the Field Event Startup Report and submit to PM.

6.2 Field Operations

Field staff responsibilities are project-specific. At a minimum, field personnel are required to ensure the following items are completed as part of field operations during drilling and soil sampling activities.

6.2.1 Field Documentation

Field activities will be documented in a bound logbook for each team and in field records as required by the project-specific work plan or SOPs. At minimum, the logbook will describe general activities performed, date and time, personnel performing the activity, and weather conditions.

For field measurements, the following additional information will be required:

- The numerical value and units of each measurement
- The identity of and calibration results for each field instrument

For sampling activities, the following additional information will be required:

- Sampling type and method
- The identity of each sample and the depth(s) from which it was obtained
- The amount of each sample
- Sample description (e.g., color, odor, clarity)

- Identification of sampling devices
- Identification of conditions that might reflect representativeness of a sample (e.g., refueling operations, damaged well casings)

Field personnel will complete required data collection/sample control forms (e.g., Chain-of-Custody, Drill logs, Field Sampling Report, etc.).

6.2.2 Drilling Logs

The geologist/engineer will log the subsurface conditions encountered in the boring, and record the information on the drilling log and the logbook. Additional pertinent information will be recorded on the drilling log, including, but not limited to, the following:

- Drilling date
- Drilling method
- Geologist name
- Location of boring/Boring identification
- Driller's name/Drilling subcontractor name/Type of drill rig
- Diameter of inner and outer sonic drill casings
- Diameter of surface casing, casing type and method of installation
- Types of drilling fluids and depths at which they were used
- Weather conditions
- Start and completion time for each boring
- Standard Penetration Test blow counts per six inch advance, if applicable
- Recovery length of each sample
- Visual description of soil using the Unified Soil Classification system (ASTM-D-2488-00)
- Depths at which each soil sample was collected for chemical or physical analysis
- Total number of samples taken
- Total depth of boring
- Boring refusal

- Water losses (if applicable)
- Water bearing strata (depth and thickness)
- Depth at which saturated conditions were first encountered
- Lithologic descriptions and depths of lithologic boundaries
- Zones of caving or heaving
- Depths at which drilling fluid was lost and amount lost
- Drilling rate
- Drill rig reactions such as chatter, rod drops, or bouncing
- Location of the boring relative to an easily identifiable landmark.

6.2.3 Drilling Procedures

Generally, drilling activities will be completed in accordance with the planned activities presented in project work plan. Additionally, the following requirements will apply to drilling activities at DDMT:

- Drilling will conform to Shelby County rules and regulations, and Rules of Tennessee Department of Environment and Conservation (TDEC), Division of Water Supply, Chapter 12-4-10.
- All necessary precautions will be taken to prevent leakage of hydraulic oil or other contaminants from the drilling rig into the borehole or onto equipment that is placed in the hole.
- The only acceptable drilling fluid to be used while advancing the borehole is water. However, water will be used only when necessary as approved by the FTL, and will be from an approved potable water source. If the onsite subcontractor and HDR personnel determine drilling fluid additives (e.g. sodium bentonite) are necessary for drilling operations, PM authorization must be obtained prior to their use.
- During drilling of boreholes with a sonic rig, soil will be collected continuously as 10-foot sections of soil core. These cores will be deposited from the drill casing into 10-foot polyethylene liners; the liners will be laid out for visual logging and sampling for headspace readings and laboratory analysis.
- The drilling subcontractor will place all soil cores on the ground near the drill rig in order for the HDR geologist/engineer to safely examine, log, and collect samples from the recovered soil core.

- The HDR geologist/engineer will maintain visual and verbal communication with the onsite subcontracted driller in order to maintain awareness of any changes in subsurface conditions, amount of water used (if any) during drilling, quantities of materials used during drilling and well installation, or any mechanical problems with the drill rig or support equipment.
- The HDR geologist/engineer will carefully and thoroughly complete all required field documentation in order to provide a complete record of drilling activities, including drill rig maintenance and repairs, subcontractor down time, subsurface conditions and geologic materials encountered.
- The HDR geologist/engineer will determine and record the depth to groundwater observed during drilling.
- When the HDR geologist/engineer is finished with visual logging and sampling of a given 10 foot section of soil core, the drilling subcontractor will place the core in an approved soil cutting disposal container.
- During drilling activities, the drilling subcontractor will notify the onsite HDR geologist/engineer of any significant changes in lithology encountered, significant changes in amount of water being used, and any mechanical problems with the drill rig.
- The HDR geologist/engineer will monitor the breathing zone for organic vapors in accordance with the procedures contained in the HASP. The tops of the boreholes will be monitored for organic vapors using a PID.
- The HDR geologist/engineer collect soil samples at specified intervals in borings for soil classification and/or chemical analysis or field screening as specified in the project-specific work plan.
- All drilling equipment will be decontaminated prior to drilling activities in accordance with SOP 9 *Equipment Decontamination*.
- Any investigative-derived waste (i.e., drill cuttings, drilling fluid) that is contaminated will be disposed as specified in the project work plan.
- Soil cuttings will be examined for contamination. If contamination is suspected, they will be noted on the boring log form and the suspect soil cuttings will be segregated.
- The HDR geologist/engineer will communicate with the PM regarding site conditions and out of scope work to be performed.

6.2.4 Boring Diameter

The boring diameter is based on a minimum of 2 inches of annular space between the outside diameter of the well casing and the borehole wall. The majority of borings and wells at DDMT are completed in the fluvial aquifer, which is underlain by the uppermost clay of the Jackson Formation/Upper Claiborne Group. For these borings, a 6-inch diameter borehole is advanced 5-10 feet into the clay; after the depth to the clay is confirmed, the boring is back-filled to just below the top of clay or to the target well depth. A borehole diameter of 6 inches allows proper installation of a nominal 2-inch outside diameter well casing.

For wells to be installed in the deeper intermediate or Memphis aquifer, a surface casing is typically installed into the uppermost clay of the Jackson Formation/Upper Claiborne Group in order to prevent cross contamination between formations. For the deeper borings, a 12-inch borehole will be advanced 10 feet into the uppermost clay and an 8-inch diameter surface casing will be installed, either welded sections of carbon steel or threaded Schedule 80 polyvinyl chloride (PVC). After placing the surface casing, the driller will lower a galvanized or PVC tremie pipe connected to a grout pumping unit through the inner annulus of the casing. The driller will pump grout through the injection pipe until the grout returns to the ground surface. The grout will cure for 24 hours before continuing to advance the borehole. Water present in the inner annulus of the casing will be pumped to a holding tank before the borehole is advanced to the target depth. A 6-inch diameter borehole will then be advanced to the target depth for installation of a 2-inch diameter well.

6.2.5 Soil Sampling Procedures

During drilling of boreholes with a sonic rig, soil samples will be collected continuously as 10-foot sections of soil cores. These cores are deposited from the drill casing into 10-foot polyethylene liners, and the liners laid out for visual logging, and to obtain samples for headspace readings and laboratory analysis, if required by the project work plan.

During advancement of the soil borings, the following sampling devices may also be used:

- Chemical Sample Collection: 2 or 3-inch diameter carbon steel split-barrel sampler lined with California brass rings (CBRs)
- Geotechnical Sample (disturbed) Collection: 2-inch diameter carbon steel split-barrel sampler
- Geotechnical Sample (undisturbed) Collection: 3-inch diameter “Shelby Tube” or thin-walled tube sampler

6.2.1.1 Soil Description

Soils will generally be described in accordance with the 1990 ASTM D-2488-90, *Standard Practice for Description and Identification of Soils* (Visual-Manual Procedure). Descriptive information to be recorded in the field will include:

- Identification of the predominant particle size and range of particle sizes
- Percent of gravel, sand, fines, or all three
- Description of grading and sorting of coarse particles
- Particle angularity and shape
- Maximum particle size or dimension

The plasticity of fines description will include:

- Color using Munsell Color System
- Moisture (dry, wet, or moist)
- Consistency of fine grained soils
- Structure of consolidated materials
- Cementation (weak, moderate, or strong)

The Unified Soil Classification System (USCS) group symbols will be used for identification. Additional information to be recorded includes: depth to the water table, caving or sloughing of the borehole, changes in drilling rate, depths of laboratory sample collection, presence of organic materials, presence of fractures or voids in consolidated materials, and other noteworthy observations or conditions, such as the locations of geologic boundaries.

6.2.1.2 Headspace Sampling

At five-foot intervals within the soil cores, the headspace will be screened with a flame ionization detector (FID) or PID. The headspace samples will be collected and analyzed using the following procedure:

- From the sampling location within the soil core, remove the top 1 to 2 inches of soil using a decontaminated stainless steel spoon.
- Partially fill two decontaminated 16-ounce containers with soil using the stainless steel spoon.

- Cover the jars immediately with aluminum foil and fasten the jar lids.
- Allow the sample vapors to equilibrate in the jars (approximately 5 minutes). If necessary, the headspace samples will be brought to a temperature of 20°C (68°F) to 32°C (90°F)
- Collect a reading from the first sample jar by puncturing the aluminum foil with the tip of a calibrated PID/FID and recording the highest reading.
- If the reading is > 10 ppm, collect a reading with the activated charcoal filter on the calibrated FID for the second jar. Determine corrected hydrocarbon measurement of the sample by subtracting the filtered reading from the unfiltered reading.

6.2.1.3 Sample Collection for Laboratory Analysis

Selected soil samples may be collected for laboratory analysis based upon the results of the headspace screening. At these selected locations, samples for volatile organic compound (VOC) analysis will be collected using an Encore or Terracore sampler, or acceptable equivalent. Samples collected for VOC analysis should be collected from the soil cores in a manner that minimizes disturbance of the sample.

The following items should be considered when collecting soil samples:

- A clean pair of new, non-powdered, disposable gloves will be worn each time a sample is collected.
- Samplers must use new, verified/certified-clean disposable or non-disposable equipment cleaned in accordance with SOP 9 *Equipment Decontamination*.
- Document field sampling, including field conditions, any problems encountered during sampling and sample appearance, in the field logbook. Samples collected will also be noted on the drilling log sheet at the corresponding depth.
- Place any unused sample material into the approved transport/disposal containers along with other drill cuttings generated during sonic drilling activities.
- When soil sampling is completed or when time permits, transfer samples to site office for final packaging. Complete chain-of-custody (COC) documentation and shipping procedures in accordance with relevant SOPs. The completed COC will remain with the samples until custody is relinquished.
- Note any problems encountered during sampling in the Field Sampling Report Form and Daily Quality Control Report Form.

- For borings where a monitoring well will be installed, a sample for total organic carbon (TOC) analysis may be collected from the interval to be screened. The TOC samples will be collected from the soil core using a pre-cleaned stainless steel spoon and placed in the appropriate laboratory supplied container.

6.2.1.3.1 Encore ™ Sampler Procedure

The procedure for collection of VOC samples using an Encore ™ Sampler are as follows:

- Remove sampler and cap from package and attach T-handle to the 5-gram sampler body.
- Quickly push the sampler into a freshly exposed surface of soil until the sampler is full.
- Carefully wipe the exterior of the sampler head with a clean disposable paper towel so that the cap can be tightly attached.
- Push cap on with a twisting motion to attach and seal the sampler.
- Attach the label onto the sampler body, place the sampler into a plastic Ziploc™ bag and place into a cooler with ice.
- Repeat steps a) through e) for the remaining 5-gram and 25-gram sampler.
- Collect a bulk soil sample for screening and moisture determination in a 2 or 4-ounce wide mouth glass jar. Fill the jar completely allowing no headspace. Place the sample in a cooler containing ice.
- Thoroughly mix remaining soil and place into specified labeled containers for remaining parameters.
- Place sample bottles into Ziploc™ or bubble bag and in an iced cooler.
- Complete COC documentation and shipping procedures in accordance with relevant SOPs.

6.2.1.3.2 Terracore Sampler Procedures

The procedure for collection of VOC samples using a Terracore Sampler are as follows:

- Label appropriate laboratory containers
- Quickly push the sampler (Terracore or equivalent) into a freshly exposed surface of soil to collect 5 grams (+ 0.5g) of sample. Also collect a bulk aliquot container for moisture content analysis in the laboratory supplied 4 ounce container.

- Carefully wipe the exterior of the sampler head with a clean disposable paper towel.
- Empty sampler into appropriate laboratory container. The cored samples must be extruded from the selected coring tool to a volatile organic analysis (VOA) vial in accordance with collection and preservation methods described in EPA method 5035A. The extruded core is transferred into a laboratory pre-weighed (tared) VOA vial with septum cap. Unpreserved VOA vials must be analyzed within 48 hours of collection, VOA vials preserved with sodium bisulfate or methanol must be analyzed within 14 days of collection.
- Place the sample into a plastic Ziploc™ bag and place into a cooler with ice.
- Complete COC documentation and shipping procedures in accordance with relevant SOPs.

6.3 Closeout

6.3.1 Daily Closeout

Perform following activities daily before leaving the site:

- Decontaminate and check condition of field equipment.
- Provide logbooks and other field documentation to FTL for review.
- Properly dispose of trash, debris and used PPE.
- Confirm that soil and water IDW have been secured in accordance with the project work plan.
- Make arrangements for shipment of samples (if applicable) and follow-up with the analytical laboratory to confirm samples arrived in good condition.
- Secure the site for the night and/or weekend.
- Prepare the daily field report as required by the project-specific work plan or SOPs and submit report to the PM. Note any problems or deficiencies in field activities.

6.3.2 Field Event Closeout

Upon completion of field activities, the FTL will view each site to verify the area has been cleared and restored as closely as possible to its prior condition. The following activities will be performed prior to the completion of each field event:

- All trash will be removed from site and disposed of appropriately

- Confirm that procedures for proper disposal of soil and water IDW have been followed in accordance with the project work plan.
- Any damage to the ground surface, including ruts, will be repaired
- All equipment is accounted for, properly decontaminated, and in good working condition. The FTL will be notified if repairs are needed
- Rental equipment has been properly cleaned, packaged, and shipped to the appropriate vendor
- Shipments are made using the correct HDR FedEx number and packages insured for the cost of the rental item
- Manufacturer's instructions are followed regarding long and short term storage for all equipment
- Rental vehicles are refueled and returned to the rental company
- HDR leased vehicles are cleaned and refueled
- All work areas have been cleaned, and tools and equipment have been stored properly

The FTL will make a final check of all drilling logs, logbooks and other field records to ensure there are no blanks or missing data and the entries are legible. The FTL will complete Field Event Closeout Report and submit to PM.

7 DATA AND RECORDS MANAGEMENT

All field forms and logbook entries will be scanned and copied to the project folder on the network file share drive within one week of the field event completion. All photographs taken during the field event will also be uploaded along with a typed photograph log (date, project and subject) to the network file share. All uploaded photographs will then be erased from the camera. All original forms will be stored on site at the field office in Memphis in the appropriate project-specific filing cabinet and task-specific labeled folder.

8 QUALITY CONTROL AND QUALITY ASSURANCE

All work will be performed in accordance with the QAPP, the project-specific work plan, and applicable SOPs. All field activities will be recorded in the logbooks in sufficient detail to reconstruct the events. No erasures or mark outs will be made on field forms or logbooks. A single line will be used to strike out errors and will be annotated with the initials and date of the editor. Boring logs will be typed into a spreadsheet provided by the CAD operator for the inclusion into computerized drill logs.

9 REFERENCES

MACTEC *RA SAP Volume I: Field Sampling Plan, Defense Depot Memphis, Tennessee, Revision 1*, *WTP-2 Drilling Operations*, and *WTP-11 Soil Sampling*. November, 2005.

Shelby County Health Department, Pollution Control Section, Water Quality Branch, <http://www.shelbycountytn.gov/DocumentCenter/Home/View/767>.

USEPA Region 4 SESD Guidance, *Design and Installation of Monitoring Wells* (SESDGUID-101-R1), January, 2013.

USEPA Region 4 SESD Guidance, *Field Equipment Cleaning and Decontamination* (SESDPROC-205-R2), December, 2011.

USEPA Region 4 SESD Guidance, *Soil Sampling* (SESDPROC-300-R3), August, 2014.

STANDARD OPERATING PROCEDURE 3 – WELL INSTALLATION, DEVELOPMENT AND ABANDONMENT

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Justin Bills

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for installation, development and abandonment of monitoring wells at Defense Depot Memphis, Tennessee (DDMT). This SOP provides general guidance; the project-specific work plan must be reviewed for specific project requirements.

2.0 OVERVIEW

Monitoring wells will be installed, developed and abandoned by a Tennessee-licensed subcontractor and supervised by an HDR geologist/engineer. Well installation and development will occur immediately after drilling and preparations should be made prior to beginning drilling operations, which are described in SOP 2 *Drilling and Soil Sampling*. This SOP incorporates past practice at DDMT as described in work and test procedures (WTPs) from the RA SAP (MACTEC, 1995) and SOPs prepared by United States Environmental Protection Agency (USEPA) Region 4.

3.0 HEALTH AND SAFETY

Proper safety precautions must be observed during drilling activities and when collecting soil samples in accordance with the site-specific Health and Safety Plans (HASP). Each individual assigned to field work must: (1) participate in the HDR Medical Monitoring Program, or subcontractor medical surveillance program, as applicable, (2) must have taken the OSHA 40-Hour course (updated with the 8-Hour OSHA Refresher, when necessary), and (3) must be certified as able to wear respiratory protection.

Each individual is required to have read and understood the HASP for the specific project activity. Upon arrival at the site, each person shall sign the acknowledgement sheet confirming their review of the HASP. Personal protective equipment (PPE) and other provisions for site safety requirements are

discussed in the HASP. At a minimum for drilling all personnel will wear a hard hat, steel toe shoes, safety glasses, hearing protection, and a high visibility outer garment.

All equipment will only be used by properly trained personnel. In particular, the use of a photoionization detector (PID) will only be performed by personnel familiar with the equipment. Proper tools will be made available to each employee as necessary. Any questions should be addressed to the Field Team Leader (FTL).

4.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Field activities will be directed by the FTL, a mid- or senior level engineer/geologist with experience in monitoring well installation, development and abandonment; junior to mid-level geologists will assist, if necessary. Field activities will be overseen by a Tennessee-licensed geologist or engineer. The well installation, development and/or abandonment will be conducted by a TN-licensed driller and crew familiar with planned activities, the project-specific work plan and HASP. At least one person on each team will have a current certification in first aid and CPR. If a fork lift is used on site the person driving the fork lift will have the proper Occupational Safety and Health Administration (OSHA) training.

The FTL will provide direction to field staff to ensure work is performed in accordance with the project documents (Quality Assurance Project Plan [QAPP], project-specific work plan HASP, and SOPs). The field staff will carefully review the project documents, conduct the work as planned, seek direction from the FTL when questions or problems arise, and carefully complete field documentation.

5.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will be identified in the project-specific work plan. Field activities should not proceed until the proper tools and equipment are available and in good working order. Usual equipment/supplies for a monitoring well installation, well development, and well abandonment will include: a PID, tape measure, knife, nitrile gloves, well pump, compressor, grout mixer, grout pump, bleach, sand, bentonite, Portland cement, well construction forms, well abandonment forms, camera, and development water containers.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.

6.0 PROCEDURES

6.1 Start-Up Activities

6.1.1 Office

Prior to leaving the office for field work, personnel will perform the following actions:

1. The Project Manager (PM) will assign a FTL to direct field activities and coordinate with project personnel. Task specific responsibilities of the FTL will be addressed in the appropriate SOP; general responsibilities include;

    - Review project project-specific work plan, HASP, and QAPP and for subcontracted work, review of the subcontract agreement.
    - Work with PM to properly staff the field activity.
    - Arrange site access with the property manager (Colliers International-Memphis Depot Industrial Park), tenants and/or property owners.
    - Confirm availability and condition of DDMT-owned equipment and order additional equipment/supplies for delivery prior to the start of each event.
    - Prepare field forms and other documentation for the planned event.
    - Confirm submittal of required Shelby County Health Department (SCHD) well installation and abandonment permit forms.
    - Confirm receipt of well permits and availability of well construction materials with subcontractor.
    - Provide all HDR and subcontracted field personnel with time and location for personnel to meet prior to beginning field activities.
    - Confirm that field staff have a valid Driver's License (or other picture identification) and current OSHA Certification in their possession prior to leaving the office.

6.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for field activities are on site.

- Review condition of DDMT-owned and rental equipment, and inventory field supplies.
- Confirm subcontractor has sufficient well construction materials on-site.
- Review locations for planned field activities for hazards, including overhead dangers such as power lines, and select location for the placement of the decontamination area, storage of decontamination and development waters.
- Confirm the exact locations of the wells to be abandoned and that the correct well is being abandoned.
- Confirm the location and length of the screened interval and the total depth of each well to be installed and developed.
- Conduct site set up activities to include posting of signage (if applicable) and delineation of work zones as required in the HASP.
- Calibrate field equipment.
- Conduct team safety meetings as required by the HASP.
- Conduct team review of the project documents including SOPs to be utilized.
- Complete the Field Event Startup Report and submit to PM.

6.2 Field Operations

Field activities will be documented in a logbook for each team and in field records as required by the project-specific work plan or SOPs. At minimum, the logbook will describe general activities performed, date and time, personnel and weather conditions. Additional information will be recorded in the log book if other field records are not used.

6.2.1 Monitoring Well Installation

Monitoring well installation will be completed in a manner consistent with relevant sections of USEPA Region 4 SESD Guidance, *Design and Installation of Monitoring Wells* (SESDGUID-101-R1), and applicable state/local requirements.

Monitoring well installation will be conducted by a licensed driller and well installation subcontractor. A qualified geologist/engineer will oversee well installation activities.

The following information will be required as part of the field documentation.

- The length of risers, screens, and end caps for each monitoring well including adjustment for riser sections cut off during installation.
- Record the type, manufacturer, and gradation of the filter sand, and the volume used for each well.
- The type and manufacturer of the Portland cement and bentonite and the volume used for the bentonite seal and grout at each well.
- Record surface completion details including: completion type, number of bollards installed, and a description of surface completion materials.

Borings for monitoring wells will be advanced using sonic drilling. The following procedure will be used to install the well casing and screen:

- If the boring was drilled deeper than the total depth of the well, backfill the boring to approximately 1 foot below the planned well depth in accordance with the work plan, either with bentonite or by allowing the formation material to collapse as the casing is raised.
- Remove the new polyvinyl chloride (PVC) or stainless steel screen and riser from manufacturer packaging and decontaminate as described in SOP9 *Equipment Decontamination*.
- Install a 10 to 20-foot section of minimum 2-inch (I.D.), threaded, flush jointed, pre-manufactured PVC or stainless steel screen inside the steel drill casing. Screen length for each well will be specified in the project work plan.
- Install solid riser to ground surface, plus stick-up (if required).
- Install the filter pack from approximately 1 foot below to 5 feet above the well screen using the gravity method through the annular opening between drill casing and well screen as the drill casing is removed. Use the sonic drilling head to vibrate the steel casing as it is slowly withdrawn to distribute and compact the filter pack around the screen and to prevent bridging. Measure the thickness of the filter pack as it is placed.
- Install a minimum 5-foot bentonite seal. If bentonite is gravity fed in dry form, the seal will be hydrated with potable water. Allow the bentonite seal a minimum of 4 hours of hydration time before grouting the annulus. If the seal is in the saturated section or if potential for bridging is an issue, a bentonite slurry can be installed using a side-discharge tremie pipe.
- Remove remaining drill casing and grout boring annulus to ground surface with grout/bentonite mixture.

- Develop the well at least 24 hours after grout installation.

6.2.1.1 Well Construction Materials

Well risers will consist of material durable enough to retain their long-term stability and structural integrity and be relatively inert to minimize alteration of groundwater samples. Selection of PVC or stainless steel for the monitoring wells is based on the primary purpose of the well, which is the detection of potential contaminants, and site-specific conditions, such as planned remedial actions.

Well materials will consist of new, threaded, flush joint PVC or stainless steel pipe, with a minimum inside diameter of 2 inches. If PVC is used, the riser pipe will conform to ASTM D 1785, Standards for Schedule 40 Pipe; deeper wells installed in the intermediate or Memphis aquifers require Schedule 80 Pipe. Materials will be new and unused and will be decontaminated prior to installation. Casing will only be joined with compatible welds or couplings that do not interfere with the primary purpose of the well. Use of solvent or glue will not be permitted.

Well screens will consist of new, commercially fabricated, threaded, flush joint, minimum 2-inch inside diameter (ID), factory slotted or continuous wrap PVC or stainless steel screen. Screen slot size will be based on previously available soil information, but will be generally sized to prevent 90 percent of the filter pack from entering the well. The screen slot size will be adjusted if site geologic conditions significantly differ from the expected conditions. Previous well installations at DDMT have generally used factory-slotted or wire-wrapped screens with 0.010-inch openings, no less than 10-feet in length, and no greater than 20-feet in length.

Silt traps will not be used in monitoring wells. A notch will be cut in the top of the casing to be used as a measuring point for water levels.

6.2.1.2 Well Design

Monitoring wells will be designed and installed in a manner to accomplish the following objectives: to collect representative groundwater samples; to prevent contamination of the aquifer by the drilling equipment; to prevent vertical seepage of surface water or inter-aquifer contamination.

Well design includes placement of the screen, installation of filter pack, bentonite seal, and grout seal. The FTL and PM will collectively make decisions on well depths, locations, screened intervals, etc. Borings at DDMT are generally drilled 10-feet into the clay unit at the base of aquifers to confirm the local presence of the lower confining unit. Well screens are generally set above the clay at the base of the aquifer; the deeper portion of the boring is filled with bentonite or formation material.

The well pipe assembly will be hung in the borehole, prior to placement of the filter pack, and not allowed to rest on the bottom of the hole to keep the well assembly straight and plumb. Centralizers will be installed at roughly 30-foot intervals beginning above the bentonite seal.

6.2.1.2.1 Screen Location

The screened intervals will be selected for each proposed well, based on visual observations of aquifer materials encountered, as recorded on the drilling log, and objectives in the project work plan. There are several water bearing units of interest at DDMT (fluvial, intermediate, and Memphis aquifer). Both the fluvial and intermediate aquifers can be found in unconfined conditions, with significant saturated thickness (>50 feet). In many areas, the saturated thickness of the fluvial aquifer is 20 feet or less. For most wells at DDMT the screen will start from the top of clay upward, for a maximum of 20 feet of screen per well. If the saturated thickness is substantially greater than 20 feet, cluster (or nested) wells may be installed to screen the entire saturated interval.

6.2.1.2.2 Filter Pack

A filter pack will be installed in the annular space between the boring and the well screen. The filter pack will consist of clean, inert, well rounded silica sand and contain less than 2 percent flat particles. The filter pack will be certified as free of contaminants by the supplier and have a grain size distribution compatible with the formation materials and the screen.

A filter pack of coarse sand (8-16 or 10-20 sieve) or medium sand (20-40 sieve) has generally been used based on site conditions at DDMT. These sand sizes were selected from grain-size analysis of the screened intervals by previous consultants at the site. If the site conditions show significant change (i.e. more gravelly, or much more clayey) from those previously encountered a grain-size analysis will be completed and filter pack design based on those results.

The filter pack will be placed from approximately 1 foot below to 5 feet above the well screen. The filter pack will not extend across more than one water-bearing unit. When sonic drilling methods are used, the filter pack will be emplaced through the nominal 6-inch diameter steel casing using the gravity method.

Prior to installation of the well casing, the total depth of the borehole will be measured from the top of the 6-inch steel drill casing by the drilling contractor to verify that the target depth has been reached. The sand filter pack will be gravity-placed through the 6-inch steel casing in lifts of approximately 1 foot. Care will be taken to prevent bridging by frequently measuring the thickness of the filter pack as it is

placed. As the steel casing is slowly withdrawn between lifts, it will be vibrated with the sonic drilling head to compact the sand filter pack.

6.2.1.2.3 Bentonite Seal

A minimum 5-foot thick bentonite seal will be installed above the filter pack in the annular space of the well. Only 100 percent sodium bentonite (pellets or chips) will be used and care will be taken to prevent bridging by frequently measuring the thickness of the bentonite as it is gravity placed. When the seal is installed above the water table, the bentonite will be hydrated with water from an approved water source. At least 5 gallons of water will be added after each 24 to 30 inches of bentonite is placed. The bentonite seal will be allowed to hydrate for a minimum of 4 hours prior to placement of the grout collar around the wells. When the seal is placed below the water table, a bentonite slurry may be installed using a side-discharge tremie pipe.

6.2.1.2.4 Grout Seal

A non-shrinking cement-bentonite grout mixture will be placed in the annular space from the top of the bentonite seal to approximately 6-inches below the ground surface. Concrete will be added in the remaining annular space during installation of the protective casing and concrete pad.

The cement-bentonite mixture will consist of 94 pounds of neat Type I Portland or American Petroleum Institute (API) Class A Cement, not more than four pounds of 100 percent sodium bentonite powder, and not more than 8 gallons potable water. A side discharge tremie pipe will be used to place the grout mixture into the annular space. The tremie pipe will be located a maximum of 10 feet from the top of the bentonite seal in deep wells to ensure even placement of grout in the annular space. Pumping will continue until undiluted grout is visible at the surface.

6.2.1.2.5 Surface Completion

Surface completion (flush-mount or stick-up) will be selected by the PM based on well location and planned land use. For flush-mount completions, the casing will be cut approximately 3 inches below ground surface and secured with a water-tight locking cap to prevent surface water from entering the well. The casing will be covered by a bolted manhole cover set in a 3-foot by 3-foot by 4-inch thick concrete pad that slopes away from the manhole. Brightly painted bollards should be installed where necessary to protect the well based on review by the FTL.

If an aboveground surface completion is used, the well casing will be extended 2 or 3 feet above ground surface and secured with a water-tight cap. The protective casing will be a steel sleeve placed over the

casing and cap; the steel sleeve diameter will be at least 4 inches greater than the casing diameter. The protective casing will be set in a 3-foot by 3-foot by 4-inch concrete surface pad. A vent hole will be drilled in the steel sleeve about 1 inch above the top of the well pad. The pad will be sloped away from the well sleeve and a lockable cap or lid will also be installed. Up to four brightly painted bollards (3-inch diameter concrete-filled steel guard posts) will be installed around each well unless the well is located in an area receiving vehicular traffic. The number and location of bollards required at each well will be determined by the FTL. These guard posts will be 5 feet in total length and installed radially from the well head. The guard posts will be installed approximately 2 feet into the ground and set in concrete just outside the concrete pad. The protective sleeve and guard posts will be brush-painted yellow or orange.

Wells will be secured immediately after well completion. Corrosion-resistant locks will be provided for both flush and aboveground surface completions. A brass survey marker will be installed in each concrete pad and the well ID will be stamped in the marker.

6.2.1.2.6 Location Survey

Following installation of the surface completion for each well, the wells will be surveyed for horizontal locations and elevations at top of casing, ground surface and well pad by a Tennessee-licensed surveyor. Vertical coordinates will be based on the North American Datum, 1927 used for all survey data at DDMT. Horizontal coordinates will be provided in the Tennessee State Plane coordinate system. Accuracy for well locations will be within 0.01 foot for elevations and within 0.1 feet for horizontal coordinates.

6.2.1.3 Well Installation Diagrams

The HDR geologist/engineer will maintain suitable logs detailing drilling and well construction practices. Well dimensions, amount, type and manufacture of materials used to construct each well will be recorded in the logbook. Additional information to be recorded in the field for the well installation diagram will include:

- Well identification.
- Drilling method.
- Installation date(s).
- Total boring depth.
- Lengths and descriptions of the screen and riser.

- Thickness and descriptions of filter pack, bentonite seal, annular grout, and any backfilled material.
- Quantities of all well construction materials used.

6.2.2 Well Development

The purpose of well development is to create good hydraulic contact between the well and the aquifer and to remove accumulated sediments from the well. Each newly installed monitoring well will be developed no sooner than 24 hours after installation to allow for adequate grout curing time. The water volume purged during development will exceed the volume of potable water or other drilling fluids used during drilling and well installation.

The wells will be developed with a surge block in conjunction with a pump sized to effectively develop the well. No detergents, soaps, acids, bleaches, or additives will be used during well development. Development will continue until clear, sand-free formation water is produced from the well and until pH, conductivity, turbidity, and temperature measurements have stabilized. Stabilization is defined when the pH is within + or - 0.1, the conductivity is + or - 5 %, and the turbidity is less than 10 nephelometric turbidity units (NTUs).

The monitoring well development protocol is as follows:

- Measure the static water level (SWL) and the depth to the top of sediment in the well.
- Record the total depth of the well (from the Well Installation Diagram).
- Calculate the volume of water in the well and saturated annulus.
- Begin developing the well using a combination of surging and pumping. Continue pumping and periodically surging until each the following criteria have been met:
    a. Fluids lost to the formation during drilling and well installation have been removed (this is a minimum requirement where conditions permit).
    b. pH, temperature, turbidity, and specific conductance have stabilized. In general, field parameters are stable when NTUs are less than 10, pH is within 0.1 on consecutive readings, and temperature and specific conductance are within 10 percent of previous readings. Natural turbidity levels in ground water may exceed 10 NTU.
    c. If feasible, monitor the SWL during purging. Adjust the purge rate to keep the SWL from dropping more than 0.3 meter from the initial SWL.

d. No sediment remains in the bottom of the well. However, it can be accepted if the sediment thickness remaining within the well is less than 1 percent of the screen length.

- In the event that the above criteria have not been met after six hours of pumping, surging, and bailing (including recharge time for poorly recharging wells), development activities will be temporarily discontinued at that well. The FTL and PM will decide whether or not to continue development.
- In the event of slowly recharging wells that will not sustain pumping or bailing, the field staff will advise the FTL as soon as a determination of estimated recharge time has been made.
- Physical characteristics of the water (suspended sediment, turbidity, temperature, pH, EC, purge rate, odor, etc.) will be recorded throughout the development operation. At a minimum, they will be recorded initially and after each well volume has been removed, or every 30 minutes, whichever comes first.
- The total quantity of water removed and final depth to the top of sediment (total depth of well) will be recorded.
- Well development equipment will be decontaminated prior to use in each newly-installed monitoring well.

6.2.2.1 Well Development Records

Well development data will be recorded on Well Development Data Sheets, which should include the following information:

- Method of development.
- The model number and type of water quality instruments.
- The model and type of water pump used for development.
- The flow rate of the pump.
- The type and technique used for surging of the well.
- Final water quality description (e.g., color, odor, clarity).
- Identification of conditions that might reflect the results of the development if it was successful or why it was not.
- Volume of water removed from the well.

6.2.2.2 Well Development Water

Development water will be drummed or stored in bulk containers. The containers will be clearly labeled with site name, well name, date, and contents. The development water will be properly disposed in accordance with investigation derived waste (IDW) procedures set forth in the project work plan.

6.2.3 Well Abandonment

Monitoring wells at DDMT are reviewed annually with regard to classification, sample frequency and utility. Wells are recommended for abandonment based on the following criteria:

1. The well is redundant: duplicates information; not in the flow pathway of on-coming plumes and not required to establish background; or analytical data will have no clear, reasonable use in future decision making.
2. The monitoring well (MW) has sustained damage and cannot be repaired, or an object that cannot be removed has become lodged in the MW.
3. The MW was installed for a specific reason that no longer applies.

Wells are scheduled for abandonment after recommendations are approved by USEPA and Tennessee Department of Environment and Conservation (TDEC).

Well abandonment will be completed in accordance with SCHD requirements following issuance of a fill and abandonment construction permit from SCHD. Well abandonment will be conducted by a TN-licensed well contractor. An HDR geologist/engineer will oversee well abandonment activities. The following procedure will be used for well abandonment:

- Total well depths will be measured and compared to depths recorded during well installation to determine if obstructions are present in the well.
- One-half gallon of bleach will be poured into the well as a disinfectant.
- The well screen and casing will be filled with grout (Portland type II cement with 5 percent bentonite) from the bottom up using a tremie pipe. After allowing the grout time to settle, additional grout will be added to fill the well casing to approximately 6 inches below ground surface (bgs).
- Surface completions including well pads and manholes will be removed at wells located in grassed or graveled areas. If necessary, the well casing will be cut off a few inches below the ground surface. The pad areas will be recovered with either topsoil/grass seed or gravel. At wells

located in concrete or asphalt-paved areas, the manhole covers will be removed and the manholes filled with concrete. Bollards will be removed at all abandoned wells.

- Surface completion materials including manholes, bollards, well lids and wells casings will be placed in a roll-off and properly disposed.

The following information will be recorded to document the well abandonment:

- The total depth of the abandoned wells and whether obstructions had to be removed.
- The amount and type of Portland and bentonite used for grouting.
- The volume of grout used to fill the well casing and the volume of water recovered during grouting.
- Disposal of surface completion materials removed during well abandonment.

6.3 Closeout

6.3.1 Daily Closeout

Perform following activities daily before leaving the site:

- Decontaminate and check condition of field equipment.
- Provide log books and other field documentation to FTL for review.
- Properly dispose of trash, debris and used PPE.
- Secure the site for the night and/or weekend.
- Prepare daily report as required by the project-specific work plan or SOPs and submit report to the PM. Note any problems or deficiencies in field activities.

6.3.2 Field Event Closeout

Upon completion of field activities, the FTL will view each site to verify the area has been cleared and restored as closely as possible to its prior condition. Trash will be removed from the site, and surface damage including ruts caused by vehicles, will be repaired.

Confirm all equipment is accounted for and properly decontaminated and in good working condition. Notify FTL if repairs are needed. Properly package and ship all rental equipment to the vendor. When shipping equipment, use the proper HDR FedEx number and insure the package for the cost of the

equipment. Follow manufacturer's instructions on long and short term storage when storing government and/or HDR equipment.

Rental trucks should be fueled and returned to the rental company as soon as possible. HDR leased trucks should also be fueled and cleaned prior to storing at the shop.

Work areas should be cleaned with tools and equipment properly stored.

The FTL will make a final check of all logbooks and other field records to ensure there are no blanks or missing data and the entries are legible.

The FTL will complete Field Event Closeout Report and submit to PM.

7.0 DATA AND RECORDS MANAGEMENT

All field forms and logbook entries will be scanned and copied to the project folder on the network file share drive within one week of the field event completion. All photographs taken during the field event will also be uploaded along with a typed photograph log (date, project and subject) to the network file share. All uploaded photographs will then be erased from the camera. All original forms will be stored on site at the field office in Memphis in the appropriate project-specific filing cabinet and task-specific labeled folder.

Well logs and sample results for new wells will be submitted to the SCHD in accordance with permit requirements.

8.0 QUALITY CONTROL AND QUALITY ASSURANCE

All work will be performed in accordance with the QAPP, the project-specific work plan, and applicable SOPs. All field activities will be recorded in the logbooks in sufficient detail to reconstruct the events. No erasures or mark outs will be made on field forms or logbooks. A single line will be used to strike out errors and will be annotated with the initials and date of the editor. Well completion diagrams will be typed into a spreadsheet provided by the CAD operator for the inclusion into computerized well diagrams.

9.0 REFERENCES

MACTEC, *RA SAP Volume I: Field Sampling Plan, Defense Depot Memphis, Tennessee, Revision 1, WTP-3 Well Installation, Development and Sampling*. November, 2005.

Shelby County Health Department, Pollution Control Section, Water Quality Branch, <http://www.shelbycountytn.gov/DocumentCenter/Home/View/767>.

USEPA Region 4 SESD Guidance, *Design and Installation of Monitoring Wells* (SESDGUID-101-R1), January, 2013.

STANDARD OPERATING PROCEDURE 4 – GROUNDWATER SAMPLE COLLECTION

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Justin Bills

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for groundwater sample collection at Defense Depot Memphis, Tennessee (DDMT). The project work plan must be reviewed for specific requirements.

2.0 HEALTH AND SAFETY

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the Health and Safety Plan (HASP) for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for groundwater sampling include the use of lead-acid batteries with bladder pumps, contact with contaminated groundwater, and contact with sample container preservatives. Material safety data sheets (MSDS) will be available on site for each chemical to be utilized during sampling activities. Staff will wear appropriate personal protective equipment (PPE), as outlined in the site safety health plan. Many of the wells are located in or near streets and parking lots with traffic; field staff should wear vests with reflective stripes or other high visibility clothing while sampling. Some wells may be located in areas with biological threats such as spiders, fire ants, snakes, and wasp nests; the wells should be checked for hazards before starting sampling activities.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Groundwater sampling will be directed by a Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with appropriate experience. Field staff will be junior to mid-level environmental professionals or environmental technicians overseen by the FTL. Sampling will be performed by two-person teams and at least one person on each team will have a current certification in first aid and CPR.

4.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will be identified in the work plan for the specific field activities to be performed. Field activities should not proceed until the proper tools and equipment are available and in good working order. Usual equipment/supplies for groundwater sampling will include: a photoionization detector (PID), nitrile gloves, pump controller, portable bladder pump, compressor, water quality meter, water level indicator tape, camera, and purge water containers.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.

5.0 PROCEDURE

5.1 Start-Up Activities

5.1.1 Office

The Project Manager (PM) will assign a FTL to direct field activities and coordinate with project personnel. General responsibilities are described in SOP 1. Task specific responsibilities include:

- Coordinate sampling activities with the PM, project chemist (PC) and analytical laboratory.
- PC will prepare the sampling plan detail (SPD) listing the wells and sample bottles for planned analyses. FTL will review the SPD, discuss any questions with PC and confirm shipment of laboratory-supplied sample containers and equipment for arrival prior to the start of sampling.
- The FTL will update the list of wells to be included in the water level sweep. An example list is provided in Attachment 3-1.
- Confirm availability and condition of DDMT-owned equipment and order additional equipment/supplies for delivery prior to the start of sampling event.
- Obtain well location maps and prepare tables showing screened interval and previous water level measurements to confirm planned sample depths.
- Prepare field forms and other documentation for the planned event.
- Schedule time and location for the initial meeting with field staff to review project information and begin work.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for field activities are on site.
- Review condition of DDMT-owned and rental equipment; inventory field supplies.
- View well locations and confirm the wells are accessible and well IDs are clearly marked.
- Review locations for planned field activities for hazards. Determine requirements for site preparation and clearance, and select location for storage of decontamination and purge waters. Confirm sufficient storage capacity for wastewater.
- Confirm the location and length of the screened interval and the total depth of the well to be sampled if not equipped with a dedicated pump or a diffusion bag.
- Conduct site set up activities to include posting of signage (if applicable) and delineation of work zones as required in the HASP.
- Review sampling activities and assignments with field staff.

5.2 Field Operations

Field records will be prepared in accordance with SOP 7 – Sample Control and Documentation. Each sampling site will be characterized by the following factors:

- Location of work
- Weather conditions: rainfall, temperature, and wind direction
- Ongoing activities that may influence or disrupt sampling efforts
- Accessibility to the sampling locations (e.g., rough terrain, fallen trees, flooding, etc.)

5.2.1 Water Level Sweep

Prior to sampling, a water level sweep will be made at listed monitoring wells to produce an accurate potentiometric map. Water level measurements will be made at the Main Installation and then the Dunn Field/Off Depot area to limit the time period required to complete the sweep for each area. Due to the number of wells, the sweep is expected to last one to two days in each area.

1. Determine if the water level probes are working properly by using two or more in one well to confirm the same depth is measured. If the depths differ by more than 0.1 feet, determine which one is malfunctioning and replace it for the project.
2. Using the water level sweep list proceed to the wells requiring water level readings. Confirm the well location by checking the well ID on the pad.
3. Inspect the area around the well for hazards, then remove the well box lid, lock and well cap.
4. Water levels should be allowed to equilibrate prior to measurement after removing sealing caps. Measurements will be made at least two minutes after removing the well cap. If pressure differential is observed when removing the well cap; an initial measurement will be made after 2 minutes and a second measurement after 5 minutes.
5. Turn the water level indicator on and slowly lower it into the well until it alerts to the water level.
6. Bring up the probe slowly until the beeping stops and slowly lower it again until it beeps; do this three times and record the average level recorded. All readings should be taken from an area marked on top of the casing; if no mark is present, use the north side of the casing.
7. Put the cap and lock back on the well casing and then close the well box. At this time assess the well condition record any cracks in the pad, missing bolts, missing caps, etc.
8. Decontaminate the water level probe before proceeding to the next well. The decontamination procedure for the water level indicator is: Hand wash the calibrated tape and probe with Alconox solution (or equivalent) and rinse with deionized (Reagent Grade II) water.

5.2.2 Water Quality Measurements

Field measurements of groundwater physical parameters are used for groundwater sampling and for independent measurements during remedial actions. The field equipment will be properly calibrated per manufacturer's instructions; calibrations will be made at the start of the day after lunch and at the end of the day. The calibrations will be checked during the day if abnormal measurements are observed. All calibration activities will be recorded in the field log books.

Field measurements will be made with a YSI 650 MDS or similar multi-probe device with flow-through cell. Flow cells add efficiency to low flow purging and field sampling applications. Calibration procedures for the YSI 650 MDS are provided in the operations manual.

Groundwater samples will be collected when water quality indicators of dissolved oxygen (DO), redox potential (ORP), pH, specific conductivity, and turbidity stabilize. Readings will be taken every 5 to 10

minutes and recorded on the Sample Collection Data sheet (Attachment 3-2). Stabilization is achieved after three successive readings are within ± 0.1 for pH, 10 millivolts (mV) for ORP, ± 5% for specific conductance, 10% for DO, and <10 nephelometric turbidity units (NTU) for turbidity. Temperature will also be measured and recorded, but will not be used as a stabilization parameter. Sampling may begin once the well has stabilized. If stabilization does not occur or turbidity cannot be reduced below 10 NTU, the FTL should be informed and samples collected after at least three well volumes have been removed.

5.2.3 Sample Collection Procedures

Groundwater samples may be collected from monitoring and injection wells, or piezometers. In most cases, dedicated bladder pumps and passive diffusion bags (PDBs) are used for sampling. In some wells a portable bladder or a disposable bailer will be used. Decontamination of portable pumps is required prior to each use in accordance with SOP 9. For new wells, purging for sampling will begin no less than 24 hours after well development is completed.

Observations made during sample collection will be recorded in the logbook and on a monitoring well purge and sampling form. The following initial steps will be followed before collecting groundwater samples in the field.

1. Locate the well to be sampled, confirm well ID and record the condition of the well.
2. Caution shall be used when opening each well to avoid fumes which may have accumulated and to prevent foreign materials from entering the well. If a persistent odor is observed, air monitoring with a PID will conducted in accordance with the HASP.
3. Measure the water level from the measuring point to the nearest 0.01-foot and record the measurement in the field logbook and on the Sample Collection Data sheet (Attachment 3-2). The measurement should be made two minutes after the well cap is removed, with a second measurement after five minutes if a pressure differential was observed.
4. Water levels will generally be measured before and during sampling. For wells with dedicated pumps, water levels will be measured only if the water is above the top of the pump. The pump will not be removed in order to obtain a water level. The water level probe should be carefully lowered down the well to minimize disturbance.
5. Decontaminate the water-level indicator and tape prior to each use. The decontamination procedure for the water level indicator is: Hand wash the calibrated tape and probe with Alconox solution (or equivalent) and rinse with deionized (Reagent Grade II) water.

6. Well depth should be obtained from well logs. Measuring total depth of wells prior to sampling should be avoided; measuring to the bottom of the well casing may cause re-suspension of settled solids.

5.2.3.1 Sampling using a Disposable Bailer

Wells will be sampled with bailers where necessary due to small diameter casing in piezometers and slow recharge or thin saturated layer in wells. New disposable bailers will be used for sampling. Purging and sampling will be conducted in a manner that minimizes the agitation of sediments in the well and formation; the bailer will not be allowed to free fall into a well.

The sampling protocol will be as follows for the collection of groundwater samples using a disposable Teflon bailer:

1. Measure the static water level prior to purging using a decontaminated electronic water level indicator. The probe of the water level indicator will be lowered into the well bore and the water level will be recorded. The measurement should be made two minutes after the well cap is removed, with a second measurement after five minutes if a pressure differential was observed.

2. Attach the Teflon coated stainless steel leader rope to the bailer and polypropylene (or nylon) rope to the Teflon coated rope. Lower the bailer into the well, until it contacts the water surface. Allow the bailer to sink and fill with a minimum of water surface disturbance. Slowly withdraw the bailer from the well, preventing the bailer and bailing line from touching the ground.

3. The well should be purged until a minimum of three well volumes is removed from the well, and the water quality indicators of DO, ORP, pH, specific conductivity, and turbidity stabilize. Readings will be taken after each well volume is removed and recorded on the Sample Collection Data sheet (Attachment 4-2). Stabilization is achieved after three successive readings are within ± 0.1 for pH, 10 mV for ORP, 5% for specific conductance, 10% for DO, and <10 NTU for turbidity. Temperature will also be measured and recorded, but will not be used as a stabilization parameter. Sampling may begin once the well has stabilized. If, after three well volumes have been removed, stabilization does not occur or turbidity cannot be reduced below 10 NTU, additional purging (up to five well volumes), should be performed. If the parameters have not stabilized within five volumes, the field team leader should be contacted for direction.

4. If the well is purged dry, a sample will be collected as soon as sufficient recharge has occurred and within 24 hours. Temperature, specific conductance, turbidity, ORP, pH, and DO will also be measured and recorded; however, stabilization of these parameters is not required.

5. After water quality indicators stabilize or the well recharges, collect samples by pouring the water from the bailer into the appropriate sample containers. This process will be repeated as necessary to fill each container.

6. Wells should be sampled in order of increasing contamination (i.e. - samples that are expected to be least contaminated will be collected before those that are more highly contaminated).

7. After samples have been collected, replace the well cap and lock the security casing.

8. Place samples into the cooler with ice, record samples in the logbook, and enter sample times into the computer on the digital chain-of-custody (COC).

9. Record field conditions, problems encountered during sampling, and sample appearance in the field logbook and include the information in the Daily Field Report (SOP 1, Attachment 1-2).

5.2.3.2 Sampling Using a Bladder Pump

The sampling protocol will be as follows for the collection of groundwater samples using a stainless steel/Teflon bladder pump:

1. For wells requiring portable bladder pumps, slowly and carefully lower the pump inlet to the mid-point of the screened interval. In cases where the entire screen is not saturated, place the pump inlet near the middle of the saturated screen, keeping in mind the limitations stated below. Many wells have dedicated bladder pumps in the well where the pump has been placed near the middle of the saturated screen.

2. Do not place pump inlet less than 2 feet above the bottom of the well, as this may cause the mobilization of bottom sediments. If saturated screen length is 2 feet or less, collect sample using disposable bailer.

3. Allow at least 1-foot of water above the inlet so there is little risk of entrainment or air in the sample.

4. Begin purging the well at a rate of 200 to 500 milliliters per minute (mL/min). All purge water will be containerized as investigation derived waste (IDW). The appropriate purge rate will be determined by monitoring groundwater drawdown. Drawdown should not exceed 0.1 meter (4 inches).

5. The discharge during purging and sampling should flow with minimal turbulence or agitation.

6. The water level should stabilize and the pump rate should allow water to recharge the well so that little or no water level drawdown is observed. Adjust discharge rate to limit drawdown.

7. Record groundwater level frequently until water level stabilization occurs. After stabilization, measure water levels at regular intervals.

8. If drawdown is greater than 0.1 meter (4 inches), decrease the discharge rate of the pump and repeat discharge and water level measurements. Repeat until the water level stabilizes to closely match the recharge rate. Record pumping rates and depths to water on the Sample Collection Data sheet (Attachment 4-2).

9. An in-line multi-probe flow-through cell will be used to monitor the indicator parameters so as not to expose the water to the atmosphere prior to measurement. During purging, water quality indicator parameters (pH, ORP, turbidity, specific conductivity, and DO) will be measured every 5-10 minutes until the parameters have stabilized. Measurement should be recorded on Attachment 4-2. A minimum of 5 sets of water quality indicator parameters should be recorded.

10. Stabilization is achieved after three successive readings are within ± 0.1 for pH, ± 10 mV for ORP, ± 5% for specific conductance, ± 10% for DO, and <10 NTU for turbidity. Temperature will also be measured and recorded, but will not be used as a stabilization parameter. Sampling may begin once the well has stabilized.

11. Specific conductance and DO usually take the longest to stabilize. Up to 2 hours of purging may be required to reach stabilization. Stabilized purge indicator trends are generally obvious and follow either an exponential or asymptotic change to stable parameter values during purging.

12. The pump will not be turned off between the purging and sampling processes.

13. If stabilization does not occur or turbidity is >10 NTU after two hours of purging, the FTL should be informed and samples collected after at least three well volumes have been removed.

14. Groundwater samples will be collected by gently filling the sample bottles with minimum turbulence once equilibrium is established. Lower the flow rate to 100 mL/min and fill sample containers as described in Section 5.2.3.4.

5.2.3.3 Sampling Using a Passive Diffusion Bag Sampler

Select groundwater samples will be collected for VOC analyses using passive diffusion bag (PDB) sampling. A typical PDB sampler consists of a low-density polyethylene tube closed at both ends and filled with deionized water. It is positioned in the well at the desired target depth by attaching it to weighted tether. The water within the bag is allowed to equilibrate with the ambient groundwater (at least two weeks) before retrieval. The sampler water is then decanted into 40 mL volatile organic analysis (VOA) vials and sent to the lab for analysis. Detailed procedures for using PDB samplers in wells can be

found in "User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells" (USGS, 2001). The following is a generalized summary of PDB sampling:

1. The top and bottom of the PDB sampler will be attached to 3/16" polyester or similar non-buoyant rope strong enough to support the weight of the sampler and subject to minimal stretch. The PDB will be suspended within the well screen at selected depths based on the measured total depth and location of the screen. Weights will be attached to the bottom of the sampler to keep it in place in the well. The sampler will be allowed to equilibrate for at least two weeks before being carefully retrieved with the attached line and the sample collected.
2. The PDBs will carefully be withdrawn from the well and inspected. Any evidence of algae or other coatings on the bag or tears in the membrane will be noted in the field book. If there are tears, the sample will be rejected.
3. The contents of the intact bag will then be transferred to pre-preserved VOA vials causing as little agitation of the sample as possible.
4. A new PDB will be filled with deionized water, and attached to the tether with zip ties, then carefully lowered into the well. The well cap, lock, and cover will be securely fastened once the PDB is in place.

5.2.3.4 Sample Collection

Groundwater samples will be collected by gently filling the sample bottles with minimum turbulence. Fill the sample bottles in the following order, as needed for the required analyses:

- Volatile organic compounds (VOCs) (no headspace)
- Carbon Dioxide, Methane, Ethane, Ethene (no headspace)
- Metabolic fatty acids (MFAs) (no headspace)
- Total organic carbon (TOC) (no headspace)

Collect the samples to be analyzed for volatile organics first, leaving zero headspace. Once the VOC sample is filled, carefully secure the cap to the vial. Turn the container upside down and look for any bubbles inside the vial. If bubbles are observed, gently remove the cap and carefully add a small amount of sample water to the container until a small meniscus forms at the rim of the vial. Gently place the cap over the meniscus and secure to the vial. Re-inspect the container for any air bubbles. If air bubbles are

observed again, repeat the sample process using a new clean VOC container. Proceed with the collection of samples for the remaining analyses, collecting the more volatile parameters first.

5.3 Closeout

Perform following activities daily before leaving the site:

- Decontaminate and check condition of field equipment.
- Provide log books and other field documentation to FTL for review.
- Properly dispose of trash, debris and used PPE.
- Store purge water in the designated area.
- Make arrangements for shipment of samples (if applicable) and follow-up with the analytical laboratory to confirm samples arrived in good condition in accordance with SOPs 7 and 8.
- Complete the Daily Field Report (SOP 1, Attachment 1-2) and submit to PM.

Upon the completion of groundwater sampling activities, the FTL will perform closeout activities per SOP 1 and complete Closeout Report (SOP 1, Attachment 1-3) and submit to PM.

6.0 DATA AND RECORDS MANAGEMENT

All field forms and log book entries will be scanned and copied project folder on the "Z" drive within one week of the field event completion. All photographs taken during the field event will be uploaded along with a typed photograph log (date, project and subject) to the "Z" drive.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

All work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs.

8.0 REFERENCES

MACTEC *RA SAP Volume I: Field Sampling Plan, Defense Depot Memphis, Tennessee, Revision 1, WTP-4 Groundwater Sampling*. November, 2005.

User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells (USGS, 2001).

SESDPROC-301-R3, *Operating Procedure: Groundwater Sampling,* 2013

SESDPROC-105-R2, *Operating Procedure: Groundwater Level and Well Depth Measurement,* 2013

Attachment 4-1

Water Level Measurement and Well Assessment Record

Sample Event: _____

Previous Measurement
3/30/2011

Well I.D	Depth to Water (ft, btoc)	Depth to Water (ft, btoc)	Date	Well Assessment
MW-03	63.56			
MW-04	71.00			
MW-05	75.49			
MW-06	58.96			
MW-07	63.60			
MW-08	59.68			
MW-10	-			
MW-13	69.39			
MW-14	72.17			
MW-15	64.90			
MW-28	54.45			
MW-31	65.50			
MW-32	-			
MW-33	52.04			
MW-37	-			
MW-42	52.89			
MW-43	116.05			
MW-44	50.81			
MW-45	54.51			
MW-51	39.22			
MW-54	75.83			

Attachment 4-2

Water Sample Collection Sheet

Site Name:_____ Project No.: _____

Sample No.:_____ Well ID.:_____

Date/Time Collected:_____ Personnel:_____

Sample Method: _____

Sample QC: Duplicate Yes No Duplicate Sample ID: _____

MS/MSD: Yes No

Well Purging Data (Fill In All Blanks)

Depth Of Sample Collection (ft, btoc) _____

Date: _____ Depth To Water (ft, btoc) _____

Time Completed _____ Total Purge _____ Units_____

Field Measurements: Fill In All Blanks

Time (24 hour)	Amount purged (ml)	pH	COND (mS/m)	TURB (NTU)	DO (mg/L)	TEMP (C°)	ORP (mV)	Water Depth (ft, btoc)

Flow Rate_____

General Comments:

_____

_____

STANDARD OPERATING PROCEDURE 7 – SAMPLE CONTROL AND DOCUMENTATION

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Justin Bills

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for sample control and identification, data recording, and proper completion of Chain-of-Custody (COC) forms.

2.0 HEALTH AND SAFETY

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the Health and Safety Plan (HASP) for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for sample handling include potential for exposure to contaminants, sample container preservatives, and injury from breakage of sample containers. Contamination levels at Defense Depot Memphis, Tennessee (DDMT) are relatively low but care should be taken to avoid exposure. Sample containers should be handled carefully; nitrile gloves and safety glasses should be used.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Sample control activities will be directed by the Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in sampling activities. The field staff, environmental professionals or technicians, are responsible for proper sample handling and documentation of the sample collection.

4.0 EQUIPMENT AND SUPPLIES

The field staff will use a pen with blue or black waterproof ink to record field activities and document sample handling in a field logbook and on field data sheets. A laptop computer with laboratory-provided software may also be used for sample documentation.

5.0 PROCEDURE

Proper field sampling and documentation help ensure sample authenticity and data integrity. These procedures describe sample collection documentation and sample handling, tracking, and custody procedures to ensure that sample integrity and custody are maintained.

If the computer is being used to scan the samples as they are collected the data recorded by the computer should be checked for correctness. The date and time on the computer should be checked prior to scanning of any samples. The sample label should be completed when the sample is collected. If the samples are being collected and a hand written COC will be used, all information should be recorded in a log book as to the type of sample, date and time collected and number of sample containers. The COC can then be filled out back at the field office in a quiet environment with out disturbances to avoid errors. The number of sample containers on the COC should be physically checked against the number of containers collected. Once this is confirmed the sample crew can properly store the samples for shipment.

5.1 Start-Up Activities

5.1.1 Office

The FTL will work with the project chemist (PC) to:

- Prepare the sampling plan detail (Attachment 7-1).
- Coordinate with the analytical laboratory and ensure that sample forms including chain of custody forms and custody seals are shipped to the site.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the FTL will confirm that required documentation and equipment for field activities are on site.

5.2 Field Operations

5.2.1 Sample Identification

Individual samples will be identified by a unique alphanumeric code (also referred to as a sample ID number or field number) which will be written on the sample label and recorded on the COC form. The sample ID will include the location and sampling event as described in Section 2.3.2 of the Quality Assurance Project Plan (QAPP). Additional information to be written on the label includes sample ID,

time and date of sample, sampler's initials, and the analytical methods to be performed, as described in Section 5.2.3 of this SOP.

Field Quality Control (QC) samples to be collected at DDMT include trip blanks, rinsate blanks, field (ambient) blanks, and field duplicates. The ID for trip blanks, rinsate blanks and field blanks will consist of the prefix TB, RB or FB, respectively, followed by a number, followed by the sampling event, as shown below:

TB-1-ODPM-9	first Trip Blank for event ODPM-9
TB-2-ODPM-9	second Trip Blank for event ODPM-9
RB-1-ODPM-9	Rinsate Blank for event ODPM-9
FB-1-ODPM-9	Field Blank for event ODPM-9

Matrix spike and matrix spike duplicate samples will also be collected. The ID for these samples will consist of the location ID, followed by the sampling event, followed by the suffix matrix spike (MS) or matrix spike duplicate (MSD), as shown below:

MW-164-ODPM-9-MS	Matrix Spike sample for well MW-164
MW-164-ODPM-9-MSD	Matrix Spike Duplicate sample for well MW-164

The identity of field duplicate samples will be concealed from the laboratory by using a consecutively numbered duplicate identifier, followed by the sampling event, as shown below:

DUP-1-ODPM-9	first field duplicate for event ODPM-9
DUP-2-ODPM-9	second field duplicate for event ODPM-9

The location of field duplicates will be recorded on the sampling plan detail (SPD) and field notebook. The final SPDs will be maintained in the project file and copies will be kept at the on-site field office. At the end of the sampling event, the FTL will send the PM and PC the final SPD with changes to field duplicate or MS/MSD sample IDs, additional blanks collected, and any other changes.

5.2.2 Field Documentation

5.2.2.1 Logbook

The logbook is a written record of sampling activities to be completed in the field during sampling. The purpose is to document field conditions or procedural exceptions that may aid in the analysis of data generated from sampling activities. The log book will have with sequentially numbered pages and information will be recorded in blue or black waterproof ink. The recorder will sign and date each entry.

Information pertaining to environmental conditions at the site during the field investigation will be noted in the field log book for each day. The following information will be recorded for each activity:

1. Activity
2. Location
3. Date and time
4. Weather conditions

For field sampling activities, the following information will be recorded, if a sampling form is not used:

1. Sample type and sampling method
2. The identity of each sample and the depth(s) from which it was collected
3. Sample description (e.g., color, odor, clarity)
4. Identification of sampling devices used
5. Identification of sampling conditions that might affect the representativeness of a sample (i.e., refueling operations, damaged casings)

5.2.2.2 Daily Field Reports

Each day the FTL will prepare a Daily Field Report (SOP 1, Attachment 1-2). The report will include daily weather, time and description of field activities, samples collected, and any problems or changes in scope that occurred that day. The report also lists field staff, subcontractors and site visitors observing field activities.

5.2.2.3 Photographs

Photographs taken for the purpose of project documentation will be noted in the field logbook. The sequential number of the photograph, photographer, date, time, location, description, and orientation of the photograph will be recorded in the logbook as the photographs are taken. The photographs and documentation will be loaded on the Z-Drive.

5.2.3 Sample Labels/Tags

Sample labels will be filled out for each sample with an indelible pen. The label will be protected from water and solvents with clear label protection tape. Any change in the pre-prepared label information will be initialed by the sampler.

5.2.3.1 Labels for Groundwater Samples

Pre-printed labels from the laboratory for groundwater sampling events contain the following information:

- Sample ID
- Preservative
- Date the bottle was prepared
- Matrix
- Tests
- Laboratory name
- Bar code

The sample collector will write in the following information:

- Date of collection
- Time of collection
- Name or initials of collector

5.2.3.2 Sample Tags for Air Samples

Sample tags from the laboratory for air sampling events contain the following information:

- Laboratory name, address, phone number and fax number

The sample collector will write in the following information:

- Client name (HDR)
- Sample ID
- Analysis (TO-15)
- Date and time of sample collection
- Sampler's initials
- Comments

5.2.4 Sample Custody

Sample custody is a part of a quality field or laboratory operation. Custody of a sample is defined as:

1. Having physical possession

2. Being in view, after being in possession
3. Having possession, then being placed in a secure area
4. Being maintained in a secure area by the person who had possession last

These custody practices will be observed in the field. They will be performed according to the procedures described in the following subsections.

5.2.4.1 COC Records

A hand-written three-part COC will be fully completed, in triplicate. The first two pages will accompany the cooler to the laboratory, and the bottom copy will be retained in the files at the field office after it is scanned into the computer file.

A computer-generated COC will have one copy printed that will accompany the cooler to the laboratory. The data used to generate the COC will be transmitted via E-mail to the laboratory and a PDF copy of the COC will be saved on the computer in the sampling file.

The information specified on the COC record will contain the same level of detail found in the site log book, with the exception that on-site measurement data will not be recorded. The custody record will include at least the following information:

- Name of person collecting the samples
- Date samples were collected
- Type of sampling conducted (composite/grab)
- Location of sampling station (including the site location)
- Number and type of containers used
- Signature of the HDR person relinquishing samples to a non-HDR person (such as a FedEx agent), with the date and time of transfer noted, and the cooler designation.
- Airbill Number

If samples will require rapid turnaround in the laboratory because of project time constraints or analytical concerns such as extraction time or sample retention period limitations, these constraints will be noted in the remarks section of the custody record. The FTL or designee will contact the laboratory to confirm the turnaround time can be achieved. The computer generated COC is for use with Microbac Laboratories only. Other laboratories will provide COCs for use.

It is not practicable to seal the sample coolers or cartons at a FedEx office; they will be sealed beforehand. The custody record will, therefore, have the signature of the relinquishing field technician, but the "relinquished to" box will not be filled in.

The duplicate custody record will then be placed in a plastic bag, taped to the underside of the cooler lid, and the cooler closed. COCs for air samples will be included in the carton. The container will be tightly bound with filament tape. Finally, custody seals will be signed by the individual relinquishing custody and affixed in such a way that the cooler or carton cannot be opened without breaking the seals.

The original and duplicate custody records and the airway bill or delivery note together constitute a complete record. The FTL will email a copy of the airbill and the COC to the PC, who will maintain the custody records as part of the analytical data file.

Custody Seals: Custody seals will be preprinted, adhesive-backed seals designed to break if disturbed. Sample shipping containers (coolers, cardboard boxes, etc., as appropriate) will be sealed in as many places as necessary to ensure security. Seals will be signed and dated before application.

Laboratory custody procedures are described in the laboratory sample handling and storage SOPs L8 and L104, included in Appendix C of the QAPP.

5.3 Closeout

Before leaving the site daily, the following procedures will be performed by on-site personnel:

- Maintain custody of samples, maintaining them as specified for the analyses to be performed.
- Prepare samples for shipment to the laboratory.
- Complete the COC forms.
- Contact the laboratory to inform them that samples will be shipped and also remind them of any special requirements for the sample analyses.
- Verify completion of logbook, ensuring that required information has been recorded.

Upon the completion of sample collection and shipment, copies of the COCs will be scanned and sent to interested parties to include the PM and PC. The FedEx tracking numbers will be checked each day to confirm the samples were delivered and the laboratory will be contacted to check on problems with the samples or COCs.

6.0 DATA AND RECORDS MANAGEMENT

All field forms, COCs, and log book entries will be scanned and copied project folder on the "Z" drive within one week of the field event completion. All original forms will be stored on site in Memphis in the filing cabinet in the proper folder labeled for the project. The PM and PC will be sent a link for the data.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

Work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs. Field activities will be recorded in the log books in sufficient detail to reconstruct the events and forms provided with the SOP will be completed. No erasures or mark outs will be made on field forms or log books. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8.0 REFERENCES

MACTEC *RA SAP Volume I: Field Sampling Plan, Defense Depot Memphis, Tennessee, Revision 1, WTP-7 Sample Control and Documentation*. November, 2005.

SESDPROC-209-R2, *Operating Procedure: Packing, Marking, Labeling and Shipping of Environmental and Waste Samples,* 2011

Attachment 7-1

EXAMPLE SAMPLE PLAN DETAIL

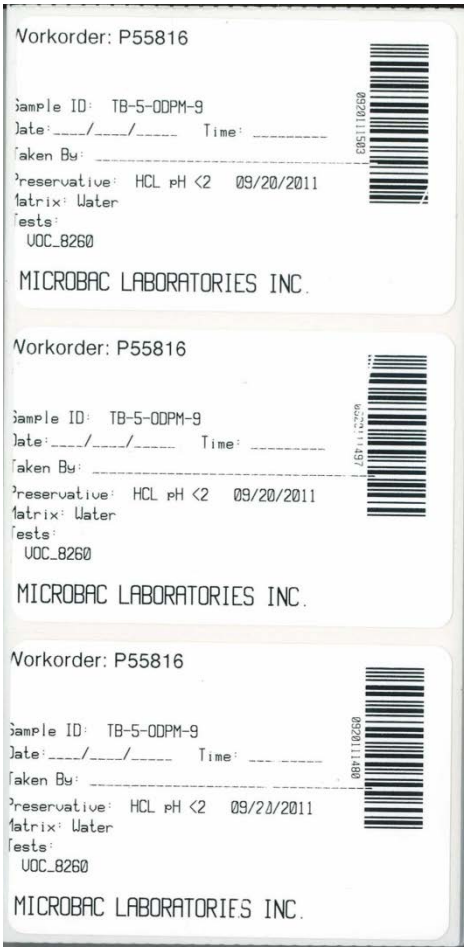
SAMPLING PLAN DETAIL (OFF DEPOT PM WELLS September 2011) - ODPM-9

Parameter	**VOCs**
Method	**8260B**
Container	**40 mL VOA**
Preservative	**HCl to pH<2**
	Cool to 4°C

#	Well ID	Sample ID	Additional	No. of Containers
1	MW-54	MW-54-ODPM-9		3
2	MW-70	MW-70-ODPM-9		3
3	MW-76	MW-76-ODPM-9		3
4	MW-77	MW-77-ODPM-9		3
5	MW-79	MW-79-ODPM-9	DUP-1	3
6	MW-148	MW-148-ODPM-9		3
7	MW-149	MW-149-ODPM-9		3
8	MW-150	MW-150-ODPM-9		3
9	MW-151	MW-151-ODPM-9		3
10	MW-152	MW-152-ODPM-9		3
11	MW-155	MW-155-ODPM-9		3
12	MW-157	MW-157-ODPM-9		3
13	MW-158	MW-158-ODPM-9		3
14	MW-158A	MW-158A-ODPM-9		3
15	MW-159	MW-159-ODPM-9	DUP-2	3
16	MW-160	MW-160-ODPM-9		3
17	MW-161	MW-161-ODPM-9		3
18	MW-162	MW-162-ODPM-9		3
19	MW-163	MW-163-ODPM-9		3
20	MW-164	MW-164-ODPM-9		3
20	MW-164	MW-164-ODPM-9-MS	MS	3
20	MW-164	MW-164-ODPM-9-MSD	MSD	3
21	MW-165	MW-165-ODPM-9		3
22	MW-165A	MW-165A-ODPM-9		3
23	MW-166	MW-166-ODPM-9		3
24	MW-166A	MW-166A-ODPM-9		3
25	MW-241	MW-241-ODPM-9		3
26	MW-242	MW-242-ODPM-9		3
27	MW-243	MW-243-ODPM-9		3
28	MW-244	MW-244-ODPM-9		3
29	MW-245	MW-245-ODPM-9		3
30	MW-246	MW-246-ODPM-9		3
31	RB	RB-ODPM-9		3
32	DUP-1	DUP-1-ODPM-9		3
33	DUP-2	DUP-2-ODPM-9		3
34	TB-1	TB-1-ODPM-9		3
35	TB-2	TB-2-ODPM-9		3

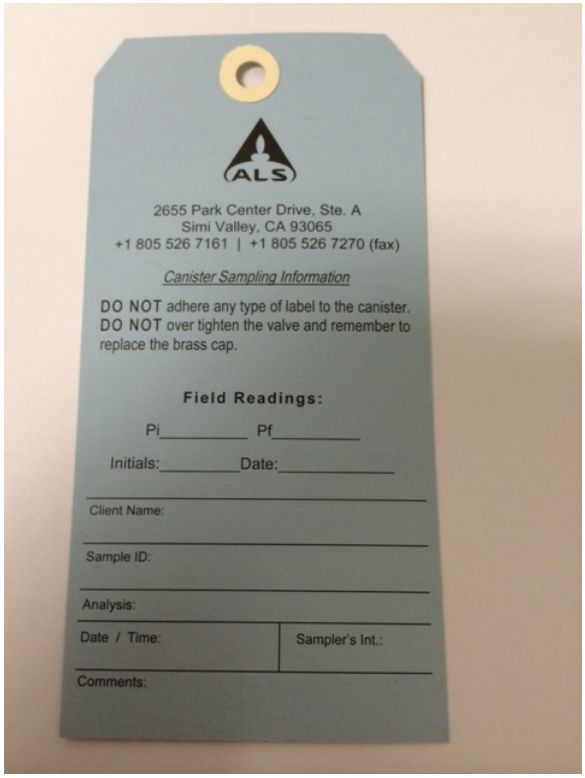
Attachment 7-2

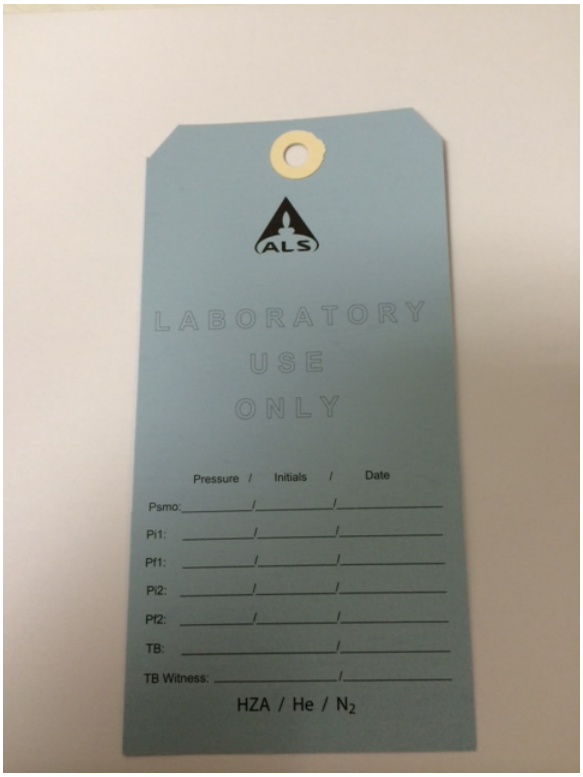
EXAMPLE SAMPLE LABELS FOR GROUNDWATER SAMPLES



Attachment 7-3

EXAMPLE SAMPLE LABELS FOR AIR SAMPLES





Attachment 7-4

EXAMPLE MICROBAC CHAIN OF CUSTODY FORM (COMPUTER)

Microbac

Chain of Custody
Chain #: 1001
Printed at : 04/26/2011 08:46

Barcode	Client ID	Tests	Collect Date	Beg. Depth	End. Depth	Notes
~~0420111~~	~~MW-91-ODLB-3~~	~~VOC_8260~~	~~04/25/2011 10:09~~	9J 4/26		
~~0420112~~	~~MW-91-ODLB-3~~	~~VOC_8260~~	~~04/25/2011 10:09~~	9J 4/26		
~~0420113~~	~~MW-91-ODLB-3~~	~~VOC_8260~~	~~04/25/2011 10:09~~	9J 4/26		
0420111	04/25/11-TB-1-ODPM-8	VOC_8260	04/25/2011 10:09			
0420112	04/25/11-TB-1-ODPM-8	VOC_8260	04/25/2011 10:09			
0420113	04/25/11-TB-1-ODPM-8	VOC_8260	04/25/2011 10:09			
0420114	DUP-1-ODPM-8	VOC_8260	04/25/2011 11:32			
0420115	DUP-1-ODPM-8	VOC_8260	04/25/2011 11:32			
0420116	DUP-1-ODPM-8	VOC_8260	04/25/2011 11:32			
0420117	MW-250-ODPM-8	VOC_8260	04/25/2011 10:30			
0420118	MW-250-ODPM-8	VOC_8260	04/25/2011 10:30			
0420119	MW-250-ODPM-8	VOC_8260	04/25/2011 10:30			
04201110	MW-251-ODPM-8	VOC_8260	04/25/2011 10:42			
04201111	MW-251-ODPM-8	VOC_8260	04/25/2011 10:42			
04201112	MW-251-ODPM-8	VOC_8260	04/25/2011 10:42			
04201113	MW-54-ODPM-8	VOC_8260	04/25/2011 11:32			
04201114	MW-54-ODPM-8	VOC_8260	04/25/2011 11:32			
04201115	MW-54-ODPM-8	VOC_8260	04/25/2011 11:32			
04201116	MW-70-ODPM-8	VOC_8260	04/25/2011 13:23			
04201117	MW-70-ODPM-8	VOC_8260	04/25/2011 13:23			
04201119	MW-70-ODPM-8-MS	VOC_8260	04/25/2011 13:23			
04201120	MW-70-ODPM-8-MS	VOC_8260	04/25/2011 13:23			
04201122	MW-70-ODPM-8-MSD	VOC_8260	04/25/2011 13:23			
~~04201123~~	~~MW-70-ODPM-8-MSD~~	~~VOC_8260~~	~~04/25/2011 13:23~~	KS 4/26		
04201125	MW-76-ODPM-8	VOC_8260	04/25/2011 13:07			
04201126	MW-76-ODPM-8	VOC_8260	04/25/2011 13:07			
04201127	MW-76-ODPM-8	VOC_8260	04/25/2011 13:07			
04201128	MW-77-ODPM-8	VOC_8260	04/25/2011 13:14			
04201129	MW-77-ODPM-8	VOC_8260	04/25/2011 13:14			
04201130	MW-77-ODPM-8	VOC_8260	04/25/2011 13:14			
04201131	MW-79-ODPM-8	VOC_8260	04/25/2011 11:17			
04201132	MW-79-ODPM-8	VOC_8260	04/25/2011 11:17			

Microbac OVD 221003014398
Received: 04/27/2011 12:56
By: BRENDA GREENWALT
(signed)

Barcode	Client ID	Tests	Collect Date	Beg. Depth	End. Depth	Notes
04201133	MW-79-ODPM-8	VOC_8260	04/25/2011 11:17			

Samples Collected on: 04/25/2011 by jbsperry
(signed)

Attachment 7-4

EXAMPLE MICROBAC CHAIN OF CUSTODY FORM (HAND)

COC No. A 23953

158 Starlite Drive
Marietta, OH 45750

Microbac

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name:

Project Contact: | Contact Phone #:

Turn Around Requirements: | Location:

Project ID:

Sampler (print): | Signature:

Program
☐ CWA
☐ RCRA
☐ DOD
☐ AFCEE
☐ Other _____

ADDITIONAL REQUIREMENTS

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold															TOTAL # (LAB USE)

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

Page _____ of _____

Attachment 7-5

EXAMPLE ALS CHAIN OF CUSTODY FORM

Air - Chain of Custody Record & Analytical Service Request

Page _____ of _____

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

ALS Project No.

Company Name & Address (Reporting Information)

Project Name

Project Number

ALS Contact:

Analysis Method

Project Manager

P.O. # / Billing Information

Phone | Fax

Email Address for Result Reporting

Sampler (Print & Sign)

Comments
e.g. Actual Preservative or specific instructions

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume			

Report Tier Levels - please select

Tier I - Results (Default if not specified) ____ Tier III (Results + QC & Calibration Summaries) ____
Tier II (Results + QC Summaries) ____ Tier IV (Data Validation Package) 10% Surcharge ____

EDD required Yes / No
Type: _____ Units: _____

Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	Cooler / Blank Temperature ____°C

STANDARD OPERATING PROCEDURE 8 – SAMPLE PACKING AND SHIPPING

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Justin Bills

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

The purpose of this Standard Operating Procedure (SOP) is to provide guidance for packing and shipping environmental samples to the laboratory for analysis. The goals for sample packing and shipping are that: 1) the integrity of the sample is maintained, and 2) no exposure to the sample contents occurs during transit. These goals should be met regardless of the method by which the samples were shipped.

Samples will usually be shipped as either environmental samples or as hazardous materials based on the expected contaminant concentrations. While the concentration of constituents in the sample is not generally known prior to shipment of the sample, inferences can be made based on the site location and knowledge of past activities, observations during collection, and past sample results. Hazardous materials are generally considered to be samples of highly contaminated media collected at or near an observed release and can consist of pure product or a mixture. Environmental samples are generally media with low-level contamination.

Relevant regulations include Department of Transportation (DOT) regulations for ground transportation (49 Code of Federal Regulations [CFR]) and the International Air Transport Association (IATA) regulations for air transportation. Common carriers (e.g., FedEx, and UPS etc.) must abide by these regulations. This SOP provides specific guidance on how to package and ship samples to achieve the stated objectives and remain in compliance with shipping regulations. If field personnel are unsure regarding current shipping regulations, they will immediately contact the selected carrier (e.g., FedEx, UPS, etc.) for guidance.

2.0 HEALTH AND SAFETY

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the Health and Safety Plan (HASP) for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for sample shipment include potential for exposure to contaminants, sample container preservatives, and injury from breakage of sample containers. Contamination levels at DDMT are relatively low but care should be taken to avoid exposure. Sample containers should be handled carefully; nitrile gloves and safety glasses should be used.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Sample packing and shipping activities will be directed by the Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in sampling activities. Field staff, environmental professionals or technicians, are responsible for proper sample handling and compliance with these guidelines.

4.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will consist of ice chests from the laboratory, clear tape, filament tape, gallon size Ziploc bags, trash bags, custody seals, bubble bags, cushion for bottom of cooler, and FedEx handle label hangers.

5.0 PROCEDURE

5.1 Start-Up Activities

5.1.1 Office

The FTL will work with the project chemist (PC) to:

- Ensure that sufficient sample containers, shipping containers/coolers and packing material are shipped to the site based on the analytical parameters, total number of samples and average number of samples to be collected per day.
- Develop guidelines on the number/type of samples per shipper based on sample type and past analytical results (i.e. volatile organic compounds [VOCs] in one cooler to limit the number of trip blanks needed and samples from high concentration wells packed in separate cooler to prevent cross contamination)
- Coordinate sample shipments to ensure laboratory personnel will be available to receive the samples if weekend or holiday shipments are planned.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the FTL will confirm that the required sample containers, sample coolers, packing material and ice are available on-site.

5.2 Field Operations

On specific projects, protocols for sample shipment will be specified in the work plan. This SOP provides general guidelines for sample packing and shipping.

- Samples will be shipped to the laboratory by an overnight courier service.
- Samples will not remain on site for more than 24 hours after collection, unless samples were collected on a weekend or there were not enough samples to make a shipment. These samples will be stored in the refrigerator at 4 degrees Celsius (°C) in a locked office until the next shipment.
- Glass sample containers will be placed inside sealed plastic bubble wrap bags or wrapped in bubble wrap and placed in plastic bags as a precaution against cross-contamination due to leakage or breakage.
- Sample bottles will be placed in coolers in a manner to limit the breakage and/or leakage during shipment. All coolers will have a bottom cushion/absorbent placed in prior to placing the samples in the cooler.
- Coolers will be lined with a heavy duty plastic garbage bag.
- Segregate highly contaminated samples, if known, by placement in a separate cooler or in separate plastic zip-lock bags.
- All coolers will have the drain plug taped closed, if present.
- Sufficient ice in plastic bags (double-bagged) will be placed in the coolers to keep the samples at 4°C throughout shipment.
- The top of the garbage bag, lining the cooler and containing the samples and ice, will be tied or adequately sealed as to prevent leakage.
- Chain-of-Custody (COC) documents will be placed in zip-lock bags and taped to the inside lid of each cooler.
- Cooler lids will be secured by wrapping with filament tape.

- The air bill will be secured to the handle of the cooler for the shipment label.
- Place Fragile and perishable stickers on all coolers. If shipping for Saturday delivery, place multiple Saturday Delivery stickers on each cooler and contact the laboratory to confirm receiving staff will be present.
- Confirm arrangements with the laboratory point-of-contact for Saturday delivery samples so that hold times and/or sample preservation are not compromised.

Custody seals will be used for sample shipments in accordance with SOP 7, Sample Control and Documentation. Custody seals are adhesive labels that are placed in such a manner that they will be visibly disturbed upon opening the shipping container or cooler. The seals will be initialed and dated upon placement. Upon receipt at the laboratory, the sample custodian will note the condition of custody seals and will also check the sample temperature, recording these items on the laboratory receipt form.

5.3 Closeout

Before leaving the site daily, the following procedures will be performed by the FTL or designated field staff:

- Ensure that the sample transport containers are properly packed and are in compliance with DOT and IATA regulations.
- Complete the Sample Handling, Packing & Shipping Checklist (Attachment 6-1).

6.0 DATA AND RECORDS MANAGEMENT

All field forms and log book entries will be scanned and copied project folder on the “Z” drive within one week of the field event completion.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

Work will be performed in accordance with the Quality Assurance Project Plan (QAPP), the specific work plan, and applicable SOPs. The Sample Handling, Packing & Shipping Checklist will be completed each day that samples are shipped. No erasures or mark outs will be made on the checklist. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8.0 REFERENCES

MACTEC *RA SAP Volume I: Field Sampling Plan, Defense Depot Memphis, Tennessee, Revision 1*, *WTP-9 Sample Packaging and Shipping*. November, 2005.

SESDPROC-209-R2, *Operating Procedure: Packing, Marking, Labeling and Shipping of Environmental and Waste Samples*, 2011

Attachment 8-1

SAMPLE HANDLING, PACKING & SHIPPING CHECKLIST

When preparing samples for shipment to the laboratory, complete this checklist to ensure that samples, documents, and materials are properly packed in the sample shipper.

Sample Event: _____

Date: _____

PROJECT SAMPLES

□ All samples, duplicates, MS/MSDs, equipment blanks, ambient blanks, and trip blanks should be included in the cooler that are listed on the COC.

□ Verify that the proper number of bottles with appropriate preservative(s) were collected for each sample

□ Verify that samples were checked for pH (except volatile samples)

DOCUMENTS

□ **Chain-of-Custody (COC)** generated for *each* cooler

□ COC reviewed for completeness, including appropriate signature(s) and date(s), and include the **courier tracking/shipping number** on the COC

□ **COC** placed in a Ziploc bag and taped to the underside of the cooler lid

□ **Custody seals** placed on the front and back of each cooler.

PACKING MATERIALS

□ Ice is "double-bagged" and is sufficient to maintain a temperature of 4◦C

□ Glass bottles placed in a bubble bag to prevent breakage and leakage

□ All coolers have a bottom cushion in place prior to placing samples in the cooler.

□ Highly contaminated samples (if known) placed together

□ **Trip blank** placed in each cooler that contains samples for VOC analyses at beginning of day

□ All VOC samples placed in same cooler to minimize the number of trip blanks,

□ Each cooler contains a **temperature blank**

Comments: (special handling or delivery requirements, highly contaminated samples, etc.)

_____

_____

Number of coolers shipped: _____

Checklist Completed By: _____ Date: _____

Note: Place the completed checklist in the project file with the associated COCs and airbill.

STANDARD OPERATING PROCEDURE 9 –EQUIPMENT DECONTAMINATION

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Justin Bills

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operation Procedure (SOP) provides guidance for proper decontamination of equipment used in sampling and collection of equipment rinsates to evaluate effectiveness of decontamination procedures.

2.0 HEALTH AND SAFETY

General Information on Health and Safety requirements is provided in SOP 1. Each individual is required to have read and understood the Health and Safety Plan (HASP) for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for equipment decontamination include exposure to contaminants from sampling equipment. Nitrile gloves and safety glasses should be used during decontamination.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Sampling equipment decontamination and rinsate sample collection will be directed by the Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in equipment decontamination and sampling activities. The field staff, environmental professionals or technicians, are responsible for following these procedures and seeking direction from the FTL when questions or problems arise.

4.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will consist of Alconox soap, deionized water (DI), tap water, paper towels, foil, and sample containers.

5.0 PROCEDURE

Proper equipment decontamination will prevent cross-contamination of samples due to residual contamination from previous sample locations and spread of contamination via sampling equipment. Proper decontamination also supports the legal defensibility of data generated during Remedial Action Operations (RA-O) and Long-Term Monitoring (LTM) activities.

Decontamination procedures will be evaluated by the collection of equipment rinsates. These samples consist of reagent water collected from final rinse of sampling equipment after the decontamination procedure has been performed. The samples are analyzed with the environmental sample to assess the adequacy of the decontamination performed.

5.1 Start-Up Activities

5.1.1 Office

The FTL will confirm that sufficient equipment and supplies are available at the site based on the number of samples and estimated field days.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the FTL will confirm that decontamination supplies and equipment are available on site and review procedures with field staff.

5.2 Field Operations

5.2.1 Decontamination Area

The location of the decontamination area, used primarily for larger pieces of equipment, will be determined in consultation with subcontractor personnel. The decontamination pad will include a sump lined with 6-mil polyethylene sheeting to collect the decontamination water. The sump will be constructed by either excavating a small area to create a depression or by elevating the edges of the sheeting. Existing concrete pads with containment areas can be used for large equipment like drill rigs. Small handheld equipment will be decontaminated in 5-gallon buckets in order to contain the water.

5.2.2 Decontamination Water Source

Tap water from the municipal water treatment system will be used as a rinse in the decontamination procedure. The FTL will be responsible for coordinating with the subcontractor personnel to secure an adequate supply of potable water for decontamination procedures. If large quantities of water are to be used, the subcontractor will rent a water meter from Memphis Light Gas and Water (MLGW). For smaller amounts, the shop water hose can be used.

5.2.3 Decontamination Procedures

The required decontamination procedure for large pieces of equipment such as drill rigs, drill casing and well materials (casing, screen, centralizers and caps) is:

1. Wash the external surface of equipment or materials with high pressure hot water and Alconox or equivalent, and scrub with brushes if necessary until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed from the equipment.
2. Air dry.
3. Decontamination waste water will be stored at the site and analyzed prior to disposal.

The required decontamination procedure for sampling equipment except the water level indicator probe is:

1. Wash and scrub with Alconox solution (or equivalent) and nylon brushes.
2. Double tap water rinse.
3. Rinse with American Society for Testing and Materials (ASTM) Type II Reagent - Grade Water
4. Wrap in oil free aluminum foil for transport.
5. Collect all decontamination rinse water in 5 gallon buckets. Rinse water will be combined with other wastewater generated during sampling activities and disposed of according to the workplan.

During water level sweeps and measurements in low-flow sampling, the water level tape and indicator in contact with groundwater will be decontaminated before initial use and before moving to a new location. The decontamination procedure for the water level indicator is:

1. Hand wash the calibrated tape and probe with Alconox solution (or equivalent).
2. Rinse with deionized (Reagent Grade II) water.

5.2.4 Equipment Rinsate Collection

When non-dedicated sampling equipment is used, the equipment will be decontaminated before initial use and after each sample is collected. An equipment rinsate sample will be collected for equipment type (bladder pump or bailer). At least one equipment rinsate will be collected for each sampling protocol (i.e. soil sampling, bladder pumps used for groundwater sampling) during each week of sampling. Equipment rinsate samples will be collected to be representative of field decontamination procedures.

Sampling Equipment: Equipment rinsates will be obtained from decontaminated bladder pumps, bailers, stainless steel split-spoons, hand augers, and stainless steel bowls with ASTM Type II water or better.

The equipment rinsate protocol will be as follows:

a. Label Sample Container - Label the sample container as outlined in SOP 7 – Sample Control and Documentation.

b. Collect Sample - After sample collection and equipment has been decontaminated as described above, an equipment rinsate will be collected. ASTM Type II water (or better) will be poured over and through the sampling equipment into a cleaned stainless steel bowl (preferably the equipment and bowl to be used on a specifically identifiable sample location). The collected water will be poured into the appropriate sample container. Repeat the process as necessary to fill each container to the required volume. Vials for volatile analysis and bottles for total organic carbon (TOC) analysis will be completely filled, leaving no air space above the liquid portion (to minimize volatilization). Check that the Teflon on the Teflon- lined silicone septum is toward the sample in the caps and secure the cap tightly. If semi-volatile compounds are to be sampled for, collect these samples next. Proceed to the collection of samples for the remaining analyses. Be careful of all pre-preserved bottles. If acids are present, open the bottle downwind and away from the body.

c. Custody, Handling and Shipping - Complete the procedures as outlined in SOP 7 – Sample Control and Documentation and SOP 8 - Sample Packing and Shipping.

5.3 Closeout

Before leaving the site daily, the following procedures will be performed by the FTL or designated field staff:

- Confirm all equipment is decontaminated and properly stored all equipment.

- Add decontamination rinse water to the wastewater storage tank
- Note equipment decontamination activities and rinsate sample collection on the Daily Field Report (SOP 1, Attachment 1-2).

6.0 DATA AND RECORDS MANAGEMENT

All field forms and log book entries will be scanned and copied project folder on the "Z" drive within one week of the field event completion.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

Work will be performed in accordance with the Quality Assurance Project Plan (QAPP), the specific work plan, and applicable SOPs.

8.0 REFERENCES

MACTEC *RA SAP Volume I: Field Sampling Plan, Defense Depot Memphis, Tennessee, Revision 1, WTP-10 Sampling Equipment Decontamination*. November, 2005.

SESDPROC-205-R2, *Operating Procedure Field Equipment Cleaning and Decontamination*, 2011

STANDARD OPERATING PROCEDURE 10 – DATA VERIFICATION, VALIDATION, QUALIFICATION AND USABILITY ASSESSMENT

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for the data verification, validation and usability assessment (hereafter called "data review" to denote all three stages) performed for analytical data generated for groundwater and vapor samples collected at Defense Depot Memphis, Tennessee (DDMT).

2.0 HEALTH AND SAFETY

There are no health and safety issues associated with the activities described in this SOP.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Initial data review will be performed by a subcontractor, Diane Short & Associates (DSA), a professional data review company with expertise in reviewing data for Department of Defense (DoD) projects.

Final data review will be performed by the DDMT Project Chemist (PC), who will be familiar with the sampling areas and data requirements at DDMT and experienced in data review.

4.0 EQUIPMENT AND SUPPLIES

A computer loaded with Microsoft Excel, Microsoft Word and Adobe Acrobat (reader level or higher) is required.

5.0 PROCEDURE

This section describes the data qualifiers that will be applied to the data during the verification and validation steps of the data review, and how the determination of usability will be performed. General guidelines for final qualification are provided; individual circumstances for data packages or specific samples may result in different qualification.

To maintain comparability among data sets for the entire DDMT project, the data validation guidelines in Appendix E, Data Quality Evaluation SOPs, of the previous version of the DDMT Quality Assurance Project Plan (QAPP) (MACTEC, 2005) and the United States Environmental Protection Agency (USEPA) Functional Guidelines (USEPA, 2008 [for organics] and 2010 [for inorganics]) have been incorporated herein.

Refer to Sections 1 and 2 and Worksheets #12, #19, #24 and #28 of the QAPP for the quality control limits to be used for data validation.

Final qualifiers will be:

- No qualification
- Non-detect (U)
- Detected and estimated (J)
- Non-detect and estimated (UJ)
- Blank contamination (B)
- Rejected (R)

5.1 Chain-of-Custody

If the chain-of-custody (COC) form was not received by the laboratory with the sample, was not signed with date and time by the sampler in the "relinquished by" box, and/or was not signed with date and time by the lab's sample receipt personnel in the "received by" box, the legal trail of custody may be compromised. A copy of the COC will be sent to the lab and the PC by the Field Team Leader (FTL) following sample shipment. The PC will examine sample receipt documentation and call or email the lab when discrepancies are identified. Custody seals should be noted as unbroken.

5.2 Sample Receipt

5.2.1 Water Samples

Water samples should arrive at the lab between 0 degrees Celsius (ºC) and 6ºC. If water samples were received warm, the lab will contact the PC immediately. The PC and Project Manager (PM) will determine whether samples should be analyzed or re-collected. If samples are analyzed and reported, generally all results will be qualified as estimated (J) or non-detect estimated (UJ).

5.2.2 Air Samples

Air samples have no temperature requirements.

5.3 Holding Times and Preservation

For samples analyzed past their holding time, generally all results will be qualified as estimated (J) or non-detect estimated (UJ) unless holding times are grossly exceeded.

5.4 Method Identification, Analyte List, and RLs/MDLs

The correct methods (SW-846 8260B, SW-846 9060 modified, SW-846 6010, RSK-175 and 830-MBA for waters, TO-15 for air samples) used for analysis must be identified on the sample result pages. If an incorrect method was used, the lab may be instructed to reanalyze samples using the correct method.

If the list of reported analytes is incorrect, or incorrect reporting limits (RLs) and methods detection limits (MDLs) are reported, the lab will be requested to report the correct analyte list or the correct RLs and MDLs.

5.5 Gas Chromatography/Mass SpectrometryTuning and Analytical Sequence

If tuning requirements were not met, the lab should not have proceeded with sample analysis. If samples were analyzed and reported after an unacceptable tune with 4-bromofluorobenzene (BFB), this will be brought to the attention of the lab PM, and it should have been mentioned in the Case Narrative.

For volatile organic compounds (VOCs) in water and air the critical ion abundance criteria for BFB are the m/z 95/96, 174/175, 174/176, and 176/177 ratios. The relative abundances of m/z 50 and 75 are of lower importance. Samples reported after an unacceptable tune may be rejected (R), or qualified as estimated (J) and non-detect estimated (UJ), according to the reviewer's judgment.

Analysis of all field and QC samples must begin within 12 hours (for waters) or within 24 hours (for air samples) of a valid BFB tune. If sample analysis began later than required, sample results will be qualified as estimated (J) or non-detect estimated (UJ). If analysis began only a short time (within 15 minutes) after the required interval, the results need not be qualified.

5.6 Initial Calibration

Initial calibration Relative Response Factors (RRFs) and % Relative Standard Deviations (RSDs) will be examined to determine whether they met required control limits.

5.6.1 Water Samples

VOC analytes with a %RSD greater than 15% should have had a linear curve fit with an r value of at least 0.995 or a quadratic curve fit with an r^2 value of at least 0.990, or the average %RSD of all analytes in the calibration curve must be 15% or less. Calibration check compounds (CCCs) must have %RSDs less than or equal to 30%. Analytes outside these limits will be qualified as estimated (J) or non-detect estimated (UJ).

A number of VOC analytes (shown below) are considered poor responders and have less stringent requirements for minimum RRF.

Poor Responders		
Acetone	Chloroethane	1,2-Dibromoethane (EDB)
2-Butanone	Chloromethane	1,2-Dibromo-3-chloropropane
2-Hexanone	Dichlorodifluoromethane	cis-1,2-Dichloroethene
4-Methyl-2-pentanone	Trichlorofluoromethane	trans-1,2-Dichloroethene
Carbon disulfide	Methyl tert-butyl ether (MTBE)	1,2-Dichloropropane
	Isopropylbenzene	Methylene chloride

All VOC analytes except the poor responders should have an RRF of at least 0.05. The poor responders should have an RRF of at least 0.01. System performance check compounds (SPCCs) must have RRFs of at least 0.1 or 0.3 as required by the method. Analytes outside these limits will be qualified as estimated (J) or non-detect estimated (UJ).

Initial calibrations for other analytes that do not meet requirements will be qualified in a similar manner as VOCs.

5.6.2 Air Samples

Analytes with a %RSD greater than 30% will be qualified as estimated (J) or non-detect estimated (UJ).

5.7 Initial Calibration Verification (Second Source Standard)

A second source standard must be analyzed after every initial calibration. An LCS can serve as a second source standard for VOCs or dissolved gases as long as it can be determined from the standard prep sheets of instrument run logs that a different standard than those used for the calibration curve was used.

5.7.1 Water Samples

Any analyte with a %D (difference or drift) greater than the control limit compared to the initial calibration will be qualified as estimated (J) or non-detect estimated (UJ).

5.7.2 Air Samples

Any analyte with a %D (difference or drift) greater than 30% compared to the initial calibration will be qualified as estimated (J) or non-detect estimated (UJ).

5.8 Continuing Calibrations

5.8.1 Water Samples

VOC CCCs must have %D values less than or equal to 20%. Other analytes should have %D values less than or equal to 20%. Analytes outside these limits with lower responses than the initial calibration will be qualified as estimated (J) or non-detect estimated (UJ). Detected analytes outside these limits with higher responses than the initial calibration will be qualified as estimated (J).

All VOC analytes except the poor responders should have an RRF of at least 0.05. The poor responders should have an RRF of at least 0.01. SPCCs must have RRFs of at least 0.1 or 0.3 as required by the method. Analytes outside these limits will be qualified as estimated (J) or non-detect estimated (UJ).

Any other analyte with a %D (difference or drift) greater than the control limit compared to the initial calibration will be qualified as estimated (J) or non-detect estimated (UJ).

5.8.2 Air Samples

All analytes must have %D values less than or equal to 30%. Analytes outside these limits with lower responses than the initial calibration will be qualified as estimated (J) or non-detect estimated (UJ). Detected analytes outside these limits with higher responses than the initial calibration will be qualified as estimated (J).

5.9 Blanks

5.9.1 Method Blank

There must be a method blank associated with each sample. Method blanks should contain no COCs above one-half the RL. Analytes detected above the RL should be discussed in the Case Narrative.

Analytes detected in the samples as well as the method blank will be qualified with a B if the sample concentration was less than five times the blank concentration (10 times for the common lab contaminants acetone, 2-butanone and methylene chloride). Blank results will not be subtracted from sample results. If the sample concentration was greater than five times (or 10 times) the blank concentration, the blank is not considered to have greatly affected sample concentration, and sample results will not be qualified.

5.9.2 Trip Blank

A trip blank must accompany all VOC water samples during sampling and shipment, in the same cooler. Trip blanks are not required for air samples.

Analytes detected in the samples as well as the trip blank will be qualified as for a method blank.

5.9.3 Rinsate Blank

A rinsate blank must be collected periodically when non-dedicated sampling equipment is used to collect water samples. Rinsate blanks are not required for air samples.

Analytes detected in the associated samples as well as the rinsate blank will be qualified as for a method blank.

5.10 Laboratory Control Sample and Duplicate (LCS/LCSD)

There must be an LCS associated with each sample. There may also be an LCSD, although this is not required. LCSs must be spiked with all COCs.

Analytes with recoveries above the control limits may be biased high and will be qualified as estimated (J) when detected; non-detect results will not be qualified. Analytes with recoveries below the control limits may be biased low and will be qualified as estimated (J) or non-detect estimated (UJ). If an laboratory calibration standard duplicate (LCSD) is also analyzed, analytes with relative percent difference (RPD) values greater than 30% will be qualified as estimated (J) when detected; non-detect results will not be qualified. All samples associated with the LCS will be qualified.

5.11 Matrix Spike and Matrix Spike Duplicate (MS/MSD)

MS/MSD samples will be indicated on the COC. MS/MSD samples must be spiked with all COCs.

5.11.1 Water Samples

One set of MS/MSD samples will be collected for every 20 field samples. Recovery limits are the lab's in-house control limits. Analytes with higher recoveries may be biased high and will be qualified as estimated (J) when detected; non-detect results will not be qualified. Analytes with lower recoveries may be biased low and will be qualified as estimated (J) or non-detect estimated (UJ). Analytes with RPD values greater than 30% will be qualified as estimated (J) when detected; non-detect results will not be qualified. Only the parent sample will be qualified.

5.11.2 Air Samples

MS/MSD samples are not collected for air samples.

5.12 Field Duplicates

Field duplicate samples will be sent blind to the laboratory. They will be designated on the COC but not identified with a specific sample location. One field duplicate sample will be collected for every 10 field samples.

Analytes detected above the RL should agree within the RPD control limit. Sample results outside this control limit will be qualified as estimated (J). Results detected below the RL will not be assessed. If one result is above the RL and the other result is below the RL, both results will be qualified as estimated (J). If one result is above the RL and the other result is non-detect, the detected result will be qualified as estimated (J) and the non-detect result will be qualified as non-detect estimated (UJ).

5.13 Laboratory Duplicates

5.13.1 Water Samples

Laboratory duplicates may be analyzed for metals in water samples. Control limits and qualification are the same as for a field duplicate.

5.13.2 Air Samples

A laboratory duplicate of an air sample must be analyzed daily. Laboratory duplicate results are assessed only if the duplicate was on a DDMT sample. Control limits and qualification are the same as for a field duplicate.

5.14 Surrogates

Surrogates are spiked into every field sample, quality control (QC) sample, and standard for VOCs in water and air.

Surrogates with recoveries above the control limits may indicate a high bias in detected sample results; all detected analytes in the sample will be qualified as estimated (J). Surrogates with recoveries below control limits may indicate a low bias in sample results; all analytes in the sample will be qualified as estimated (J) or non-detect estimated (UJ).

5.15 Internal Standards

Internal Standards are spiked into every field sample, QC sample, and standard for VOCs in water and air.

Internal standards with recoveries or retention times outside control limits may indicate interferences in the sample matrix or poor purging.

All analytes associated with an internal standard that has an area outside control limits will be qualified as estimated (J) or non-detect estimated (UJ).

If an internal standard has a retention time outside control limits, the chromatogram and quantitation report will be examined to determine possible impact on the detected or non-detected sample results. Retention times outside control limits may lead to false positive or false negative results for other analytes.

5.16 Usability Assessment

The HDR PC will assess the Precision, Accuracy/bias, Representativeness, Comparability, Completeness, and Sensitivity (PARCCS) parameters and determine overall usability of the data. In general, non-rejected data will be considered usable. Measurement error will be deemed within acceptable limits when project data quality objectives (DQOs) as assessed by PARCCS parameters are met. The PC will write a brief assessment of data usability for each data package.

6.0 DATA AND RECORDS MANAGEMENT

This section details the distribution of data files from the laboratories to HDR, DSA, and the project files.

6.1 Data Files from Laboratories

The laboratories will email to the HDR PC the Level III data package in PDF format, an electronic data deliverable (EDD) file in Excel, and the ERPIMS files (Sample, Test and Result) to the PC. The PC will save these files to the appropriate folders on the HDR network Z: drive. The laboratories will send PDF Level III data packages directly to DSA.

Hardcopy (paper) data files are not required for this project.

6.2 Data Files from HDR

The HDR PC will email the PDF Level III data package and the Excel EDD to the HDR Project Manager (PM). The PC will email the Excel EDDs to DSA.

6.3 Data Files at DSA

DSA will perform data review (the three steps described in section 3.0 of this SOP) and write a report that summarizes what was reviewed, what decisions were made, and what qualifiers were applied to the data. DSA's report format (redacted for confidentiality and to omit sections related to inorganic samples) also serves as their SOP and is located in Attachment 9-1 of this SOP.

DSA will add a field to the Excel EDD file and apply qualifiers as discussed in their report.

6.4 Data Files from DSA to HDR

When DSA has completed the data review, they will email the report and the EDD file to the HDR PC.

6.5 Data Files at HDR

The PC will save the report and EDD file to the appropriate folders on the HDR network Z: drive. The PC will make a copy of the EDD file, with the same name plus "-final". The PC will open the "final" file, add a field named "Final_Qualifier" at the end of the fields, and record final qualifiers. Qualifiers for undetected results (U) do not all need to be copied to this field, unless the final qualifier is UJ or B or R, which will be entered into this field.

When all the EDDs have been completed for a sampling event, the PC will email the database manager the location of the files to create result tables to be used in reports.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

All work will be performed in accordance with the QAPP, the specific work plan, the specific sampling plan details (SPD) and applicable SOPs.

8.0 REFERENCES

MACTEC Engineering and Consulting, Inc. (MACTEC), 2005. *Remedial Action Sampling and Analysis Plan, Volume II: Quality Assurance Project Plan, Defense Depot Memphis, Tennessee, Revision 1*. November 2005.

United States Environmental Protection Agency (USEPA), 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.* June 2008.

United States Environmental Protection Agency (USEPA), 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review.* January 2010.

Attachment 10-1

EXAMPLE DSA ORGANIC DATA QUALITY REVIEW REPORT – WATER SAMPLES

Volatile Organics by SW-846 Method 8260B (GC/MS)

SDG _____

PROJECT Memphis Defense Depot, LS-13 Sampling for HDR, Denver

LABORATORY _____

SAMPLE MATRIX Water SAMPLING DATE _____

NUMBER OF SAMPLES 77, including 6 trip blanks, 1 rinse blank, and 7 field duplicates

ANALYSES REQUESTED SW-846 8260B (VOA by GC/MS)

SAMPLE NUMBER See result forms attached and associated EDD

DATA REVIEWER: _____

QA REVIEWER: Diane Short & Associates, Inc. INITIALS/DATE: _____ _____

Telephone Logs included Yes____ No __X_

Contractual Violations Yes____ No __X_

The project QAPP (11/05), the EPA Contract Laboratory Program National Functional Guidelines for Organic Review, 1999 and 2001, and the SW-846 Method 8260B have been referenced by the reviewer to perform this data validation review. The EPA qualifiers have been expanded to include a descriptor code and value to define QC violations and their values, per the approval of the Project Manager. Per the Scope of Work, the review of these samples includes Level III validation of all chains of custody, calibrations and QC forms referencing the QC limits in the above documents.

Attachment 10-1

I. DELIVERABLES

A. All deliverables were present as specified in the Statement of Work (SOW), SW-846, or in the project contract.

Yes __X__ No _____

This report has been requested to include the following review: QC, hold times, sample integrity (Chains of Custody, sample login), and summary calibrations.

B. Chain of Custody documentation was complete and accurate.

Yes __X__ No _____

No qualifiers have been added for Chain of Custody (COC) issues, and the Project Manager will update COC per the following notes to complete the project record. These chains were complete.

C. Samples were received at the required temperature, preservation and intact with no bubbles.

Yes __X__ No _____

EPA regulations (see Federal Register, March 12, 2007, 40CFR Part 122) require only that the temperature of samples delivered to the laboratory be equal to or less than 6 °C. The sample temperature conditions are fully compliant with applicable regulations.

SDG L110xxxxx: The laboratory notes that TB-5 samples had headspace > 6 mm.

Analyses were performed on samples without headspace. As these are trip blanks, the client data are not considered to be impacted.

II. ANALYTICAL REPORT FORMS

A. The Analytical Report or Data Sheets are present and complete for all requested analyses.

Yes __X__ No _____

B. Holding Times

Attachment 10-1

1. The contract holding times were met for all analyses [time of sample receipt to time of analysis (VOA) or time of extraction to time of analysis].

Yes __X__ No _____

2. The Clean Water Act (40 CFR 136) or method holding times were met for all analyses (14 days from time of sample collection to analysis or extraction).

Yes __X__ No _____

III. INSTRUMENT CALIBRATION – GC/MS

A. Initial Calibration

1. The Response (RF) and Relative Response Factors (RRF) and average RRF for all compounds for all analyses met the contract criteria of > 0.05 or > 0.01 for poor responding volatiles.

Yes __X__ No _____ NA _____

Method 8260: Per the Project Manager, the 2001 EPA CLP validation guidance has been applied to the common "poor responders." Calibration response factors below 0.05 have historically been observed for Acetone, 2-Butanone, and 4-Methyl-2-pentanone. The validation guidance used for this project allows for a response of 0.01 for these compounds if spectral integrity can be verified at low concentrations. These spectra are not commonly provided and are not part of the deliverable for this data set. The laboratory has been tasked with providing to the client verification that the 0.01 RF is valid. If the spectral verification is available, data are not qualified for response factors greater than 0.01 and less than 0.05 for "poor responders." No data have been qualified.

Most of the low-responding compounds are highly water-soluble and capable of hydrogen bonding with water. This decreases their purge efficiency and results in the relatively low response. The implication of this low purge efficiency is that a relatively low absolute recovery of such compounds is achieved in the purge step of the analysis. If this recovery is consistent, reasonable accuracy and precision can be achieved in a given matrix, which is indicated for the lab matrix by acceptable recoveries in LCS and calibration checks. However, this causes these targets to be more sensitive to matrix variations that impact purge efficiency (such as ionic strength or the presence of varying levels of soluble non-target organic material) than are the more hydrophobic compounds typically analyzed by this method, and as a result they are more likely to exhibit matrix bias.

2a. The relative standard deviation (RSD) for the five point calibration was within the 30% limit for the CCCs.

Yes __X__ No _____ NA _____

This is a method requirement and indicates that the analytical system is in control.

2b. The relative standard deviation (RSD) for the five point calibration was within the 30% limit for all other compounds, the average % RSD was < 15%, or a linear curve was used.

Yes __X__ No _____ NA _____

3. The 12 hour system Performance Check was performed as required in SW-846.

Yes __X__ No _____ NA _____

B. Continuing Calibrations

1. The midpoint standard was analyzed for each analysis at the required frequency, and the QC criterion of > 0.05 (> 0.01 for CLP 2001 VOA) was met.

Yes __X__ No _____ NA _____

2. The percent difference (% D) limits of ± 25% were met. The 2001 NFG also allow for 40% D for the "poor responders." For other compounds, the QAPP notes rejection of detected compounds with % D > 40%.

Yes _____ No __X__ NA _____

See the table below. When there are no detections, no qualification is required unless the % D is biased low and so large as to indicate a significant probability of false negatives. Qualification is required for a % D biased high for detected compounds only. This requires that the RF is acceptable to verify the non-detect status, which is the case here. Data are qualified "JC#", where # is the % D. There could be variability to the data as there is variability to the response.

The QAPP indicates that compounds in a run should be rejected if the % D is > 40%. We interpret this to mean that non-detects should be rejected and that detected compounds should be "J" qualified, which is the normal validation process for rejection. Professional judgment is that high bias CCVs with a % D greater than

40% should not be rejected for non-detects if the response factors are sufficient to ensure verification of the non-detect. Non-detects with % D values > 40% are qualified "RC#", where # is the % D.

The table below shows the outliers observed in CCVs for this report.

SDG	Batch	Analyte	% D	Bias	Qualifier
L110xxxxx	WGxxx	Bromomethane	27.5	high	None, ND
	WGyyy	Bromomethane	33.6	high	None, ND

IV. GC/MS INSTRUMENT PERFORMANCE CHECK

The BFB (VOA) performance check was injected once at the beginning of each 12-hour period and relative abundance criteria for the ions were met.

Yes __X__ No _____ NA _____

V. INTERNAL STANDARDS

The Internal Standards met the 100% upper and -50% lower limits criteria, and the Retention times were within the required windows.

Yes __X__ No _____ NA _____

VI. SURROGATE STANDARDS

Surrogate spikes were analyzed with every sample.

Yes __X__ No _____

And met the recovery limits defined in the QAPP of 70 – 130% for VOA water or 75 – 125% for soil samples.

Yes __X__ No _____

VII. MATRIX SPIKE/MATRIX SPIKE DUPLICATE

A. Matrix Spike (MS) and Matrix Spike Duplicate (MSD) were analyzed for every analysis performed and for every 20 samples or for every matrix whichever is more frequent.

Yes __X__ No _____

There are eight MS/MSD samples associated with the 77 non-QC client samples. This meets the recommendation of 1 per 20 field samples. As this is an ongoing project an overall adherence to the 1:20 frequency is monitored by the Project Manager.

B. The MS and MSD percent recoveries were within the limits defined in the QAPP of VOA at 70 – 130% with five compounds allowed to be within 60 – 140%.

Yes _____ No __X__ NA _____

The full target list has been spiked. Qualifiers are added for all outliers as described here. Please refer to the project EDD for a detailed list of qualifiers added.

The table below shows the outliers observed in MS/MSD samples for this report. Results have been qualified per the QAPP as "JMS#", where # is the % recovery. Data could be biased high or low in approximate proportion to the spike recovery. Only detected data are qualified for high recovery. Data are not qualified if four times (4x noted in table) =the spike amount is less than the amount in the parent sample. Only the parent sample is qualified.

SDG	Parent Sample	Analyte	MS	MSD	Bias	Qualifier
L110xxxxx	XXX	Carbon disulfide	124	132	high	None, ND

C. The MSD relative percent differences (RPD) were within the defined contract limits for VOA of 30% water or 40% soil, with five compounds allowed to be > 40% RPD.

Yes __X__ No _____ NA _____

Qualifiers are added only when the MS or MSD recovery is also out of limits. Data are qualified "JD#", where # is the RPD. As the RPD increases, the matrix precision decreases.

D. The MS/MSD were client samples.

Yes __X__ No _____ NA _____

Attachment 10-1

VIII. LABORATORY CONTROL SAMPLE

A. Laboratory Control Sample (LCS) was analyzed for every analysis performed and for every 20 samples.

Yes __X__ No _____

B. The LCS percent recoveries were within the limits defined in the QAPP for VOA of 80 – 120% for water or 75 – 125% for soil. Five compounds are allowed to be 60 – 140%. If an LCS and LCSD are analyzed, both samples must have the same compounds out for data to be qualified.

Yes _____ No __X__

The full target list has been spiked. When a high LCS recovery is associated with a non-detect in samples, no qualifier is added since the indicated bias is high. When the target is detected, data are qualified "JL#", where # is the recovery. Data could be biased high proportional to the LCS percent recovery. All results associated with low recoveries are qualified, and data could be biased low.

The table below shows the outliers and the limits applied per the QAPP. The limits are specified based on the matrix. Qualifiers are added for all outliers as described here, but the Project Manager may consider reversing some of these when the limits fall within the marginal exceedance limits (60 – 140%). Please refer to the project EDD for a detailed list of qualifiers added.

SDG	Batch	Analyte	% Recovery (LCS/LCSD)	Bias	Qualifier
L110xxxxx/ L110xxxxy	WGxxx	Dichlorodifluoromethane	129	high	None, ND

IX. BLANKS

A. Method Blanks were analyzed at the required frequency and for each matrix and analysis.

Yes __X__ No _____

B. No blank contamination was found in the Method Blank.

Yes __X__ No _____

C. If Field Blanks were identified, no blank contamination was found.

Yes _____ No __X__ NA ____

When analytes are present in both the Field Blank and the associated samples, the results in the samples are qualified in the same manner as for Method Blanks. For clarity, the qualifiers used in this case are "UTB#" for Trip Blanks or "UFB#" for Rinse Blanks, where # is the associated blank value. Results added are shown in the table below. No qualifiers have been applied.

SDG	Sample	Analyte	Result	Qualifier
L110xxxxx	XXX	Methylene Chloride	0.538	None, ND

X. FIELD QC

If Field Duplicates were identified, they met guidance for VOA of RPD of < 30% for water or < 50% for soil. For values reported at < 5 × the reporting limit (RL), a difference of 2 × RL for water or 3.5 × RL for soil samples is used as guidance. This is referred to as the CRDL Rule. Data are not qualified for Field Duplicates as these are evaluated for the total project by the Project Manager.

Yes _____ No __X__ NA _____

There are xxx identified field duplicates as described in the following table.

SDG	Parent Sample	Field Duplicate	Observations
L110xxxxx	XXXMW-21-LS-13	DUP-1	OK

XI. SYSTEM PERFORMANCE

A. The RICs, chromatograms, tunes and general system performance were acceptable for all instruments and analytical systems.

Yes _____ No _____ NA __X__

Not part of this review level.

B. The suggested EQLs for the sample matrices in this set were met.

Yes __X__ No _____ NA _____

XII. TCL COMPOUNDS

A. The identification is accurate and all retention times, library spectra and reconstructed ion chromatograms (RIC) were evaluated for all detected compounds.

Yes _____ No _____ NA __X__

Not part of this review level.

B. Quantitation was checked to determine the accuracy of calculations for representative compounds in each internal standards quantitation set.

Yes _____ No _____ NA __X__

Not part of this review level.

XIII. TENTATIVELY IDENTIFIED COMPOUNDS

TICs were properly identified and met the library identification criteria.

Yes _____ No _____ NA __X__

Not part of this review level.

XIV. OVERALL ASSESSMENT OF THE CASE

The laboratory has complied with the requested method. Data are fully usable after consideration of qualifiers. The following is noted:

<u>Sample Preservation</u>

EPA regulations (see Federal Register, March 12, 2007, 40CFR Part 122) require only that the temperature of samples delivered to the laboratory be equal to or less than 6 °C. The sample temperature conditions are fully compliant with applicable regulations.

SDG L110xxxxx: The laboratory notes that XXX samples had headspace > 6 mm.

Analyses were performed on samples without headspace. As these are trip blanks, the client data are not considered to be impacted.

Continuing Calibrations

See the table within the body of this report. When there are no detections, no qualification is required unless the % D is biased low and so large as to indicate a significant probability of false negatives. Qualification is required for a % D biased high for detected compounds only. This requires that the RF is acceptable to verify the non-detect status, which is the case here. No qualifiers have been applied.

Matrix Spikes

There are eight MS/MSD samples associated with the 77 non-QC client samples.

See the table within the body of this report. Results have been qualified per the QAPP as "JMS#", where # is the % recovery. Data could be biased high or low in approximate proportion to the spike recovery. Only detected data are qualified for high recovery. Data are not qualified if four times the spike amount is less than the amount in the parent sample. Only the parent sample is qualified. Data have been qualified with a low bias only for cis-1,2-dichloroethene in samples XXXX.

Laboratory Control Samples

See the table within the body of this report. When a high LCS recovery is associated with a non-detect in samples, no qualifier is added since the indicated bias is high. When the target is detected, data are qualified "JL#", where # is the recovery. Data could be biased high proportional to the LCS percent recovery. Data for vinyl chloride and carbon tetrachloride have been qualified for slightly high recoveries.

Field Blanks

See the table within the body of this report. When analytes are present in both the Field Blank and the associated samples, the results in the samples are qualified in the same manner as for Method Blanks. For clarity, the qualifiers used in this case are "UTB#" for Trip Blanks or "UFB#" for Rinse Blanks, where # is the associated blank value. No data have required qualification.

Field QC

There are seven identified Field Duplicates. See the table within the body of this report. No data have been qualified.

Attachment 10-2

EXAMPLE DSA ORGANIC DATA QUALITY REVIEW REPORT – AIR SAMPLES

ORGANIC AIR QUALITY REPORT

METHOD TO-15

SDG: _____

PROJECT: Memphis Defense Depot DDMT Fluvial soil vapor extraction for HDR Inc. (formerly e2m)

LABORATORY: Microbac, subcontracted to Columbia Analytical Services Laboratories, CA

SAMPLE MATRIX: Air

SAMPLING DATE (Month/Year): March, 2011

NUMBER OF SAMPLES: 9 samples including one field duplicate

ANALYSES REQUESTED: Summa Canister VOA TO-15

SAMPLE NO.: See project EDD for sample IDs

DATA REVIEWER: Diane Short

QA REVIEWER: Diane Short & Associates, Inc. INITIALS/DATE: _____

Telephone Logs included Yes____ No __X__

Contractual Violations Yes____ No __X_

The EPA CLP National Functional Guidelines for Organic Data Review, 2001 (SOP), EPA Method TO-15 current updates have been referenced by the reviewer to perform this data validation review. The EPA qualifiers have been expanded to include a descriptor code and value to define QC violations and their values, per the approval of the HDR/e2m Project Manager. Per the Scope of Work, the review of these samples includes validation of all QC forms and submitted calibrations referencing the QC limits in the above documents.

Attachment 10-2

DELIVERABLES

All deliverables were present as specified in the Statement of Work (SOW) or in the project contract.

Yes _X__ No ____

Note an extended list of volatile compounds was reported. Level III data packages were submitted and Level III validation was performed for holding times, chain of custody, calibrations and QC.

II. ANALYTICAL REPORT FORMS

A. The Analytical Report or Data Sheets are present and complete for all requested analyses.
Yes __X__ No___

B. Holding Times
The contract holding times were met for all analyses (Time of sample receipt to time of analysis (VOA) or extraction and from extraction to analysis). Contract holding times for TO-15 canisters is 30 days from date of collection.

Yes ___X__ No____

C. Chains of Custody

Chains of Custody were present and were complete with signatures, sign-offs and complete entry of data. Canisters were properly sampled and received.

Yes __X___ No ____

The project manager is informed of the following and the project record is being updated.

There are gaps from relinquishment to sample receipt. The courier is identified as FedEx and there is no airbill number on the chain or log-in. The client notes that the coolers are often sealed before the airbill number is known.

D. Canister Pressure
Canister pressures were measured and recorded for initial vacuum check, initial field vacuum, final field reading, lab initial pressure and final pressure.

Yes ___X___ No _____ NA _____

Attachment 10-2

Pressures were reported for the field initial and final pressures and the laboratory final pressure. The pressure changes are not as large as for some other samplings, but these are highly contaminated samples most of which have required some dilutions even at the reported volume.

All readings met the limits or exceptions were noted and pressure corrected

Yes ___X__ No ____ NA ____

III. INSTRUMENT CALIBRATION

A. Initial Calibration – GC/MS
1. The Relative Response Factors (RRF) and average RRF for all compounds for all analyses met the required criteria.

Yes __X__ No____ NA____

Minimum response factors are not defined by the method but meet routine Method 8260 limits. This method does not involve purging water samples. Consequently, all targets, including the typically poor-purging compounds, normally have response factors that are acceptable per validation criteria for volatiles.

The relative standard deviation (RSD) for the five-point calibration was within the 30% limit.

Yes ___X__ No ____

B. Continuing Calibration – GC/MS
1. The RRF standard was analyzed for each analysis at the required frequency and the QC criteria were met

Yes __X__ No____ NA____

Minimum response factors are not defined by the method, but met validation guidance. There were 3 calibrations as there were 2 days of analysis for dilutions.

2. The percent difference (%D) limits of 30% were met.

Yes __X__ No ____

Outliers were not client compounds.

IV. GC/MS INSTRUMENT PERFORMANCE CHECK

Attachment 10-2

A. The BFB performance check was injected once at the beginning of each 12-hour period and relative abundance criteria for the ions were met.
Yes ___X__ No____ NA ____

Tunes were provided and were acceptable.

V. INTERNAL STANDARDS

A. Area Limits
The Internal Standards met the 100% upper and -50% lower limits criteria and the Retention times were within the required windows.

Yes __X___ No____ NA ____

B. Retention Times
The relative retention times of the internal standards and sample compounds met the ± 0.06 RRT units limit.

Yes __ X ___ No____ NA ____

VI. SURROGATE

Surrogate spikes were analyzed with every sample.

Yes __X___ No ____

Note that three surrogates are used. Method 8260 requires 3 surrogates, but one is acceptable for TO-15.

And met the recovery limits defined in the current contract

Yes __ X _ No ____

VII. MATRIX SPIKE/MATRIX SPIKE DUPLICATE

A. Matrix spike (MS) and matrix spike duplicates (MSD) were analyzed for every analysis performed and for every 20 samples or for every matrix whichever is more frequent.

Yes____ No ____NA ___X__

Spikes are not amenable to canister analysis and are not required. Laboratory duplicates are required and are provided by the laboratory. See below.

B. The laboratory duplicate relative percent differences (RPD) were within the defined contract limits. Method requirements are 25% maximum RPD.

Yes ____ No ____ NA__X_

For validation purposes, only results > 5x PQL are qualified for RPD outliers. For results < 5x PQL, results are qualified if the absolute difference is greater than 2x PQL. The qualifier added is JD#, where # is the RPD or the absolute difference observed, as appropriate.

The laboratory duplicates was sample FSVE-SVEC-2Q11-NS. RPDs were reported above the limit, but these were low level results that met the 2 x PQL criteria.

VIII. DUPLICATE CONTROL SAMPLES

A. Duplicate Control and Duplicate Control Sample Duplicates similar to Laboratory Control Samples (LCS) were performed for every set.

Yes _X_ No ___

B. And percent recoveries were acceptable at 70 – 130%.

Yes _X___ No ____

For air data, the laboratory limits are used as there are no air limits defined in the QAPP. There was an LCS reported for all 3 days of analysis.

C. And Relative Percent Differences were within lab limits.

Yes ___ No____ NA__X__

LCSDs have not been performed, and are not required by the method.

IX. SHIFT CHECKS

Shift checks were performed and were within time limits.

Yes __X__ No____

X. BLANKS

Attachment 10-2

A. Method Blanks were analyzed at the required frequency and for each matrix and analysis.

Yes __X___ No____

This is a nitrogen blank run with each set.

B. The method blank was free of contamination.

Yes _____ No ___X__

Methylene chloride was reported in all 3 blanks

4/26/11 at 0.14 ug/m3; 4/28/11 at 0.16 ug/m3; 4/29 at 0.15 ug/m3.

The samples have been diluted for most reported results. The blank is multiplied by a factor determined from the reported MRL for each sample/compound. See the EDD and table at the end of the report for the final blank value as data are qualified BMB#, where # is the blank corrected value. Only data that are less than 10 x the blank (corrected for dilution) are qualified.

C. If Field Blanks were identified, they were free of contamination.

Yes _____ No ____ NA ___X___

There were no field blanks identified.

D. Contamination level was less than 0.03 mg/cubic meter before samples were analyzed per the method.
Yes __X__ No____ NA _____

Reporting units include both ppbv and ug/m3.

XI. FIELD QC

A. If Field duplicates or Performance Check Compounds were identified, they met the RPD or % recovery criteria for the project.

Yes ___ No __X__ NA___

One field duplicate pair is reported: FSVE-SVEG-2Q11: -NS and DUP. These are regularly sampled locations and the precision is built in as the sites are sampled routinely. Qualifiers of JFD#, where # is the RPD (or the difference for low level values) are added for field duplicate differences. When results are > 5x the reporting limit, a 35% RPD is used to identify potential deviations. When results are < 5x the

reporting limit, an absolute difference between the results that is < 2x PQL is considered to be acceptable reproducibility. (The laboratory uses MRL not PQL for these reports). Note that the times of collection indicate that these samples are not collected at the same time, but are sequential samples. An RPD of 50% is recommended for a precision limit for these samples. The QAPP does not define air QC.

Parent		DUP	RPD	Qualifier
Cis-1,2-dichlorothene	32	59 ug/m3	59	JFD59
Chloroform	1000	1800 ug/m3	57	JFD57
Carbontetrachloride	190	360 ug/m3	62	JFD62
Trichlorethene	580 (not diluted)	960 ug/m3 (diluted)	49.3	JFD49
Tetrachloroethane	80	150 ug/m3	61	JFD61
1,1,2,2-tetrachloroethane	560	910 ug/m3	48	JFD48

XII. TCL COMPOUNDS

A. The identification is accurate and all retention times, library spectra and reconstructed ion chromatograms (RIC) were evaluated for all detected compounds:

Yes __X_ No____ NA___

It is noted that there are high dilutions for tetrachloroethane; 1,1,2,2-tetrachloroethane, trichloroethene and chloroform and some other compounds. No dilution factors are noted on the results forms but dilutions have been estimated from the MDLs. For compounds that are reported from a re-analysis at the higher dilution, the lab has added a "D" flag. All the samples are at least 1.5 times the MRL of the blanks indicating a general overall lower volume or dilution. Sample SVEF has MRLs 15 times higher than the baseline (method blank), SVEA at 4 times, EFF at 2.4 times and SVEG and DUP at 7.5 times.

B. Quantitation was checked to determine the accuracy of calculations for representative compounds in each internal standard set

Yes___ No ____ NA___X__

OVERALL ASSESSMENT

Data are considered to be usable for project purposes after consideration of qualifiers or comments. Points of significance are summarized below:

Note an extended list of volatile compounds was reported. Level III data packages were submitted and Level III validation was performed for holding times, chain of custody, calibrations and QC.

Calibration

Minimum response factors are not defined by the method, but met validation guidance. There were 3 calibrations as there were 2 days of analysis for dilutions.

Laboratory Duplicate

The laboratory duplicates was sample FSVE-SVEC-2Q11-NS. RPDs were reported above the limit, but these were low level results that met the 2 x PQL criteria.

Method Blanks

Methylene chloride was reported in all 3 blanks

4/26/11 at 0.041 ppbv; 4/28/11 at 0.046 ppbv; 4/29 at 0.042 ppbv.

The samples have been diluted for most reported results. The blank is multiplied by a factor determined from the reported MRL for each sample/compound. See the EDD and table at the end of the report for the final blank value as data are qualified UMB#, where # is the blank corrected value. All qualifiers are from the 4/26/11 analysis. Only data that are less than 10 x the blank (corrected for dilution) are qualified.

Field Duplicates

One field duplicate pair is reported: FSVE-SVEG-2Q11: -NS and DUP. These are regularly sampled locations and the precision is built in as the sites are sampled routinely. Qualifiers of JFD#, where # is the RPD (or the difference for low level values) are added for field duplicate differences. When results are > 5x the reporting limit, a 35% RPD is used to identify potential deviations. When results are < 5x the reporting limit, an absolute difference between the results that is < 2x PQL is considered to be acceptable reproducibility. (The laboratory uses MRL not PQL for these reports). Note that the times of collection indicate that these samples are not collected at the same time, but are sequential samples. An RPD of 50% is recommended for a precision limit for these samples. The QAPP does not define air QC.

Attachment 10-2

Parent		DUP	RPD	Qualifier
Cis-1,2-dichlorothene	32	59 ug/m3	59	JFD59
Chloroform	1000	1800 ug/m3	57	JFD57
Carbon tetrachloride	190	360 ug/m3	62	JFD62
Trichlorethene	580 (not diluted)	960 ug/m3 (diluted)	49.3	JFD49
Tetrachloroethane	80	150 ug/m3	61	JFD61
1,1,2,2-tetrachloroethane	560	910 ug/m3	48	JFD48

Reporting Limits

It is noted that there are high dilutions for tetrachloroethane; 1,1,2,2-tetrachloroethane, trichloroethene and chloroform and some other compounds. No dilution factors are noted on the results forms but dilutions have been estimated from the MDLs. For compounds that are reported from a re-analysis at the higher dilution, the lab has added a "D" flag. All the samples are at least 1.5 times the MRL of the blanks indicating a general overall lower volume or dilution. Sample SVEF has MRLs 15 times higher than the baseline (method blank), SVEA at 4 times, EFF at 2.4 times and SVEG and DUP at 7.5 times.

TABLE OF QUALIFIED DATA

Lab ID	Client ID	Compound	Result ppbv	Qualifier
P1101503-001	FSVE-SVEA-2Q11-NS	Methylene Chloride	0.75	BMB.17
P1101503-002	FSVE-SVEB-2Q11-NS	Methylene Chloride	0.1	BMB.063
P1101503-003	FSVE-SVEC-2Q11-NS	Methylene Chloride	0.6	BMB.062
P1101503-004	FSVE-SVED-2Q11-NS	Methylene Chloride	0.095	BMB.062
P1101503-005	FSVE-SVEE-2Q11-NS	Methylene Chloride	0.084	BMB.063
P1101503-006	FSVE-SVEF-2Q11-NS	Methylene Chloride	3.4	BMB.61
P1101503-007	FSVE-SVEG-2Q11-NS	Methylene Chloride	2.4	BMB.31
P1101503-003DUP	FSVE-SVEC-2Q11-NS	Methylene Chloride	0.576	BMB.06
P1101503-007	FSVE-SVEG-2Q11-NS	cis-1,2-Dichloroethene	8	JFD59
P1101503-007	FSVE-SVEG-2Q11-NS	Chloroform	210	JFD57
P1101503-007	FSVE-SVEG-2Q11-NS	Carbon Tetrachloride	30	JFD62
P1101503-007	FSVE-SVEG-2Q11-NS	Trichloroethene	110	JFD49
P1101503-007	FSVE-SVEG-2Q11-NS	Tetrachloroethene	12	JFD61
P1101503-007	FSVE-SVEG-2Q11-NS	1,1,2,2-Tetrachloroethane	81	JFD48
P1101503-009	FSVE-SVEG-2Q11-DUP	cis-1,2-Dichloroethene	15	JFD59
P1101503-009	FSVE-SVEG-2Q11-DUP	Chloroform	370	JFD57
P1101503-009	FSVE-SVEG-2Q11-DUP	Carbon Tetrachloride	58	JFD62
P1101503-009	FSVE-SVEG-2Q11-DUP	Trichloroethene	180	JFD49
P1101503-009	FSVE-SVEG-2Q11-DUP	Tetrachloroethene	22	JFD61
P1101503-009	FSVE-SVEG-2Q11-DUP	1,1,2,2-Tetrachloroethane	130	JFD48

Attachment 10-3

DSA PROPRIETATRY LIST OF DATA VALIDATION QUALIFIERS

General to all:

JD# duplicate precision, # = value of the Relative Percent Difference (RPD)

JH# holding time exceeded, # = number of days (hours for some wet chem. analytes)

JL# laboratory control sample recovery, # = value of the percent recovery of the LCS

JMS# matrix spike recovery, # = value of the percent recovery of the spike

JT# temperature exceedence, # = temperature in degree C. exceeding holding time

R_# rejected data for associated reason noted in this list or below (R replaces 'J')

UB# blank contamination for the following contaminant sources, the qualifier can be expanded:

UEB equipment blank

UFB field blank

UPB laboratory preparation blank

Organic Data:

JC# calibration accuracy, # = a) a whole number for initial and continuing calibration % RSD or %D, b) a decimal number for response factors, or c) 0.9xx for linear curve

JCCAL or JICAL– denotes continuing or initial calibration if that level of specificity is required on the project

JI# internal standard recovery, # = value of the percent recovery of the internal standard for the specific sample

JN tentatively identified compound

JP# second column confirmation when 2 column difference > 25%, # = RPD of 2 results (for low level values, < 5 x RL, just JP, no number)

JS# surrogate recovery, # = percent recovery of surrogate spike, can be further specified as JSUR#

JQ identification issue, usually poor spectra or interferences

UB# blank contamination, # = highest concentration of method blank affecting data

UTB# trip blank contamination, # = value of TB compound (x dilution)

Attachment 10-4

DIANE SHORT & ASSOCIATES, INC.

PROPRIETARY DATA VALIDATION USABILITY SUMMARY

GENERAL TO ALL ANALYSES

Data are qualified referencing the USEPA Contract Laboratory Program (CLP) data validation guidance with the usability modifications defined by the Data Validator. Data validation qualification is noted by a "J" or "R" qualifier next to the reported data value. The "J" indicates that one or more of the method quality control (QC) limits have been violated and the data may be estimated. The "R" qualifier indicates that the data are considered to be rejected due to significant deviations from the acceptance limits. In order for the qualifiers to be useful in determining the effect of the violation on the data, codes for the violation(s) and a numeric value of the violation are appended to the qualifier.

The USEPA CLP laboratories 'flag' data on the Form I in the "Q" field. These 'flags' are not to be confused with the data validation qualifiers. 'Flags' are notations of laboratory procedures and/or QC alerts and are not necessarily indicative of data qualification. They are not to be used as qualifiers of data. The only code used by the laboratory that must be transferred over with lab data is the "U", undetected, code indicating that the value reported is the project reporting limit and that the analyte was not detected in the sample above the method detection limit.

Holding Times or sample integrity

JH#**,** where # is the number of days exceeding the holding time. Some wet chemistry methods have holding times in hours which will be noted in the report. Data could possibly be biased low as the number of days (hours) exceeds the allowed holding time due to loss of the compound.

JT#, where # is the degrees in temperature over the method temperature limit. Data could be biased low due to analyte degradation or other metabolic conversion.

JP, denotes a preservation issue, usually improper pH for inorganics. If there is a preservation issue for organics, a new qualifier may need to be defined in order to avoid confusing it with the 2 column JP qualifier.

Attachment 10-4

Matrix Spike Accuracy

JMS#, where # is the value of the percent recovery of the matrix spike. The QC limit is usually defined by the laboratory using historic control charts for the particular matrix of the sample. For inorganic data a set limit of 75-125% is often used. Given that a matrix spike is also a duplicate sample, the limit for soil samples is extended for some projects. Data whose percent recoveries are less than the established limit could possibly be biased low with respect to the extent of the recovery. Data whose percent recoveries are greater than the limit could possibly be biased high with respect to the extent of the recovery. Undetected data are not qualified for high spike recoveries. For organics, only the parent sample is qualified. For inorganics, the entire set associated with the QC sample is qualified. The %R can indicate:

- the accuracy of the laboratory analytical procedures and instrumentation,
- the geochemical interaction of the specific analyte with the sample matrix, or
- the homogeneity or reproducibility of the sample aliquot.

Laboratory Control Sample (LCS) Accuracy

JL#, where # is the value of the percent recovery of the LCS from the true value or established laboratory limits. The LCS is a measure of laboratory method accuracy. All data associated with the LCS are qualified. If the solid LCS is outside of the defined range, the reviewer calculates a percent recovery from the mean of the range and reports that recovery. Undetected data are not qualified for high LCS recoveries. Organic data may only be qualified for the LCS when the MS/MSD is also out of control for the same compounds. The percent recovery of each analyte from the LCS standard can indicate:

- the percent efficiency of the sample digestion procedure in the laboratory, or accuracy of the analytical method and instrumentation.

ORGANIC ANALYSES

BLANK CONTAMINATION

UB#, where # is the value of the highest blank affecting the data. These data are considered to be fully usable as undetected values. The reported value is considered to be due to contamination from preparation, general laboratory contamination or solvents, or from field contamination. The extent of the contamination is reflected in the value of the blank. Any positive value reported above the MDL is considered to be contamination. When the blank value has not been reported and the determination has

been made from a direct comparison of the raw data blank to the raw data sample, no number follows the qualifier. For the common laboratory contaminants (e.g., methylene chloride, acetone, phthalates), only values less than 10 times the blank value are qualified. For other contaminants, values less than 5 times the blank value are qualified. If there are field blanks, the qualifier may be modified to UMB for method blank contamination and UFB for field blanks or UTB for trip blanks.

MATRIX SPIKE DUPLICATE PRECISION

JD#, where # is the value of the relative percent difference (RPD) between the %Rs of the spikes. The RPD is an absolute number and a high or low bias cannot be determined. The larger the number is over the limit, the greater the difference between the two reported sample values. This may indicate the nonhomogeneity of the sample matrix or inadequate sample preparation. Data should be used knowing that there is a range of values around the reported value. Only the parent sample is qualified, and usually only if there is also a spike out of control.

SURROGATE SPIKE ACCURACY

JS#, where # is the surrogate spike recovery. See matrix spike as application is the same.

Calibration Accuracy

JC#, where # is a whole number for initial and continuing calibration curve data or a decimal number (0.0xx) for response factors or correlation coefficient (.9xx). JICAL may also be used for initial calibration and JCCAL for continuing calibration if the distinction is determined to add to the usability of the data.

For initial calibration, the number indicates the deviation from the relative response factor per the relative standard deviation (RSD). The RSD limit is usually 20-30 percent. For continuing calibration, # is the percent difference (%D) of the continuing calibration standard from the initial calibration average response factor. The limit is usually from 15-25 percent. As the value increases, the range of the quantitation could possibly increase, therefore increasing the estimation of the reported value. Undetected data are not qualified for these calibration violations if the response factors indicate that the compound can be detected if present.

When # is a decimal value, usually less than 0.05, it is the value of the average initial response factors or daily continuing calibration response factor. These data could be false non-detects or biased low due to the lack of sensitivity of the method for the qualified compound.

When # is a decimal value, usually less than 0.995, the value is the correlation coefficient of the linear curve used for initial calibration. As the value decreases, the range of the quantitation could possibly increase, therefore increasing the estimation of the reported value. Undetected data are not qualified for these calibration violations if the response factors indicate that the compound can be detected if present.

Internal Standards

JI#, where # is the value of the percent recovery of the internal standard (IS) area counts for the specific sample. The %R is calculated from the 12-hour average. Values greater than 100 percent indicate quantitation could be biased high. Values less than 50 percent indicate quantitation could be biased low. The raw data should be evaluated, however, to determine if there is an overall suppression of the results. Evaluation of the surrogate and matrix spike recoveries can sometimes give an indication of the impact of the internal standard on the data calculation. Data associated with the given IS are qualified. If there are several IS compounds out of limits and there is a trend to the recoveries, all data will be qualified per the average recovery.

LINEAR RANGE

JE indicates that the value exceeded the linear range of the instrument. A numeric bias cannot be determined, but the bias would be low. These compounds are routinely re-analyzed at a dilution and that value should be used for project decisions. For all other compounds, the lowest dilution should be reported.

Tentatively Identified Compounds (TICs)

JN. The laboratory flags TICs that are not on the method list of standard compounds, but which are reported from electronically stored library spectra. Identification may be accurate, and quantitation is estimated due to lack of daily standard. The JN may also be applied when second column confirmation has not been performed for identified compounds.

Attachment 10-4

Second Column Confirmation

JP indicates that the reported number has a percent difference greater than 25 percent from the second column (quantitation column or confirmation column). When the difference between the two values is greater than 25 percent, it is possible that the higher of the two values was due to interferences. The # after the 'P' is the value of the % difference between the values. Most laboratories report the lower of the two column results in their analytical report. However, data usability reviews for those compounds with greater than 25% RPD will be completed and the more accurate of the two column results will be reported. If no distinction can be made between the two results, the higher of the two will be included in the final report.

DDT/Endrin Breakdown

JX#, where # is the value of the DDT/endrin breakdown. When this number is >20%, it is possible that DDT is being broken down due to column or instrument problems and the data could be biased low due to loss of the compound.

IDENTIFICATION ISSUES

JQ is usually used to denote that an identification is questioned due to poor spectra (missing masses, or mass ratios that do not match reference) or chromatographic interferences.